When you finish reading a magazine bearing this notice, place a 1-cent stamp on this notice, mail the magazine, and it will be placed in the hands of our soldiers, sailors or marines. NO WRAPPING. NO ADDRESS.
A. S. Burleson, Postmaster General.

GENERAL LIBRARY
AUG 19
UNIV. OF MICH.

SCIENTIFIC AMERICAN

Entered as second class matter June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

A TYPICAL AMERICAN OIL FIELD IN ACTION—[See page 163]

Vol. CXXI. No. 7
August 16, 1919

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 10 Cents
$5.00 a Year

TO those who have known the service rendered by the individual organizations marketing the Hess-Bright deep groove type of bearings, the S K F Self-aligning type and the Atlas brand of steel balls, a massing of this experience and technical abilities will assure engineering cooperation of a practical and impartial character.

S K F Industries is now in position to undertake the examination of any technical problem involving the performance of the above-named products, without the possibility of manufacturing bias.

Our research work will constantly question existing standards for material, design or application, and aims to develop more exact data and methods for the solution of anti-friction problems.

American manufacturers are invited to avail themselves of this bearing service at any time.

S K F INDUSTRIES, INCORPORATED

Sales, Service and Research Division

165 Broadway New York

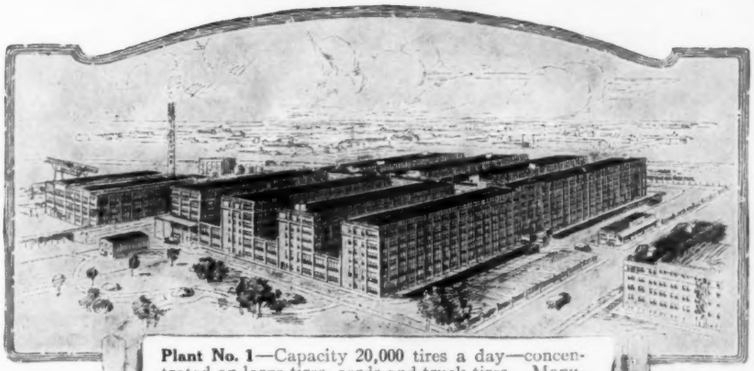
554

SKF INDUSTRIES

Hess-Bright Ball Bearings
S K F Ball Bearings
Atlas Steel Balls
Gronkvist Chucks
Transmission Hangers

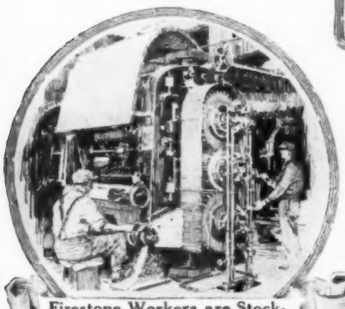
Why Firestone is Giving Extra Value in Tires

Firestone Singapore Headquarters saves car owners $1,000,000 a year getting first choice of rubber at low cost and shipping direct.

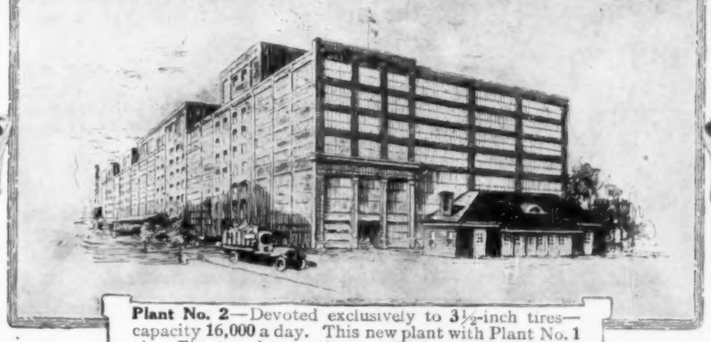


Plant No. 1—Capacity 20,000 tires a day—concentrated on large tires, cords and truck tires. Manufacturers study it, technical colleges use it, as an example of efficiency in manufacture and organization.

The Firestone Rim Plant—Devoted exclusively to Firestone Rims. Vast as is its present capacity it is inadequate to supply the demand for Firestone Rims.



Firestone Workers are Stockholders—90% of them—with a financial interest in giving every customer the best work.



Plant No. 2—Devoted exclusively to 3½-inch tires—capacity 16,000 a day. This new plant with Plant No. 1 gives Firestone largest tire capacity in America. Builds the most nearly perfect 3½-inch tire constructed and saves from 10% to 30% on every factory operation.

Firestone Park—A beautiful home community. Firestone men put more into their work because they get more out of it.

Firestone Clubhouse—Another step in the Firestone building of an organization that can do things better than others. Firestone advantages attract and hold best men.

Branch Houses in 63 leading cities serving 42,000 Firestone dealers—wide distribution economically handled, is another reason for ext a value in Firestone tires.

Fabric Mill—To insure the best without having to add a premium to price of tires and to get uniform quality and supply, Firestone invested in this mill. You benefit in long mileage tires at low price.

Firestone Park Bank—Firestone makes saving easy and alluring. And Firestone has established a Free Insurance Fund. Men with assured futures work better. You benefit in extra mileage.

This is the

Firestone

Year

Do you know that—

a hot surface of this measured area wastes ⅛ of a ton of coal each year?

Few people realize that this condition exists if the temperature within a pipe, for example is 230° Fahrenheit (the temperature of steam at 5 lbs. pressure) and the temperature of the air surrounding the pipe is 70° Fahrenheit—a very moderate condition.

If it is steam heat—

Size of steam Pipe.	
2"	$ .55
3"	1.40
4"	1.80
5"	2.20
6"	2.65

The waste in dollars per year per linear foot of pipe, coal at $10.00 per ton, 1 lb. steam pressure — temperature of air around pipe 70° Fahrenheit.

Read the remedy to the right.

If it is hot-air heat—

Size of hot air pipe.	
8"	$1.65
9"	1.85
10"	2.10
12"	2.45

The waste in dollars per year per linear foot of pipe, coal at $10.00 per ton. Air in pipe 150° Fahrenheit air around pipe 70°.

Read the remedy to the right.

If it is hot-water heat—

Size of hot water pipe.	
2"	$ .67
3"	1.00
4"	1.25
5"	1.55
6"	1.85

The loss in dollars per year per linear foot of pipe, coal at $10.00 per ton. Water in pipe 180° Fahrenheit. Air around pipe 70° Fahrenheit.

Read the remedy to the right.

EVERY hot surface radiates heat. If this heat goes where it is not required, it is wasted and so is the coal that was burned to produce it. Opposite are some actual figures on such wastes—based on average conditions in American homes like yours.

The Remedy

Insulation correctly designed, manufactured and applied will reduce heat loss from hot surfaces as much as 90%. Efficient insulation must be made of material that does not conduct heat and that combines with this property the necessary strength and durability.

Johns-Manville Asbestocel Insulation has all these desirable characteristics. It is made for application to steam, hot-air and hot-water systems. Other Johns-Manville Materials: Sponge felt and 85% Magnesia for high pressure steam, Anti-Sweat and Zero for cold water, Combination Built-Up for Brine and Ammonia.

Inspect your heating plant for exposed hot surfaces on pipes, boilers and heaters, and for sections not *properly* insulated.

Have your steamfitter apply Asbestocel to pipes, boilers or heaters, sealing all cracks and joints, finishing boiler and heater surfaces with Johns-Manville Insulating Cement. In this way you will save the added coal that must be burned when there is waste.

H. W. JOHNS-MANVILLE CO., New York City, *10 Factories—Branches in 63 Large Cities*

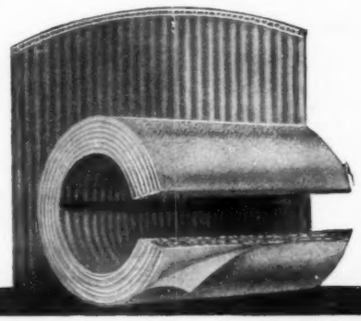
Unfortunately many materials used for "covering" pipes are not efficient heat insulations—not only because their constituent materials are inferior, but because their construction is incorrect or faulty.

To aid you in buying, Asbestocel is shown here in two forms:

In sectional form for fitting around steam and hot-water pipes.

In flexible roll form, for fitting around hot-air pipes, heaters, etc.

We recommend Asbestocel rather than air cell because of its construction, viz: the cells run around the pipe—not lengthwise thus preventing circulation of air.



JOHNS MANVILLE SERVICE COVERS THIS CONTINENT

Through—

Asbestos

and its allied products

INSULATION
that keeps the heat where it belongs

CEMENTS
that make boiler walls leak proof

ROOFINGS
that cut down fire risks

PACKINGS
that save power waste

LININGS
that make brakes safe

FIRE PREVENTION PRODUCTS

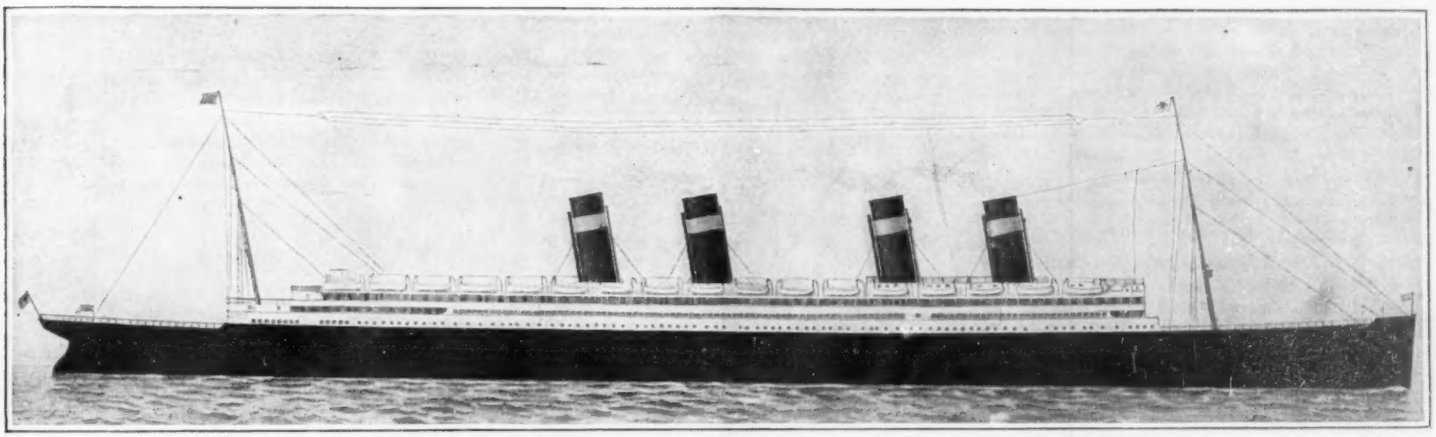
JOHNS-MANVILLE
Serves in Conservation

SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXI. NUMBER 7 | NEW YORK, AUGUST 16, 1919 | 10 CENTS A COPY $5.00 A YEAR



How the 1,000-foot steamer planned by the United States Shipping Board will appear when in service

Our Proposed 1,000-Foot Steamers

WE are to have one-thousand-foot steamers—two of them—which will be the largest afloat as compared with existing steamers. According to a recent announcement of the United States Shipping Board, two such giant steamers have been planned, and it is assured that the vessels will be constructed as rapidly as possible. Together with the plans for these vessels is a plan for the development of port and terminal facilities at Fort Pond Bay, at the eastern end of Long Island, which, to be sure, is as interesting as the giant steamers themselves.

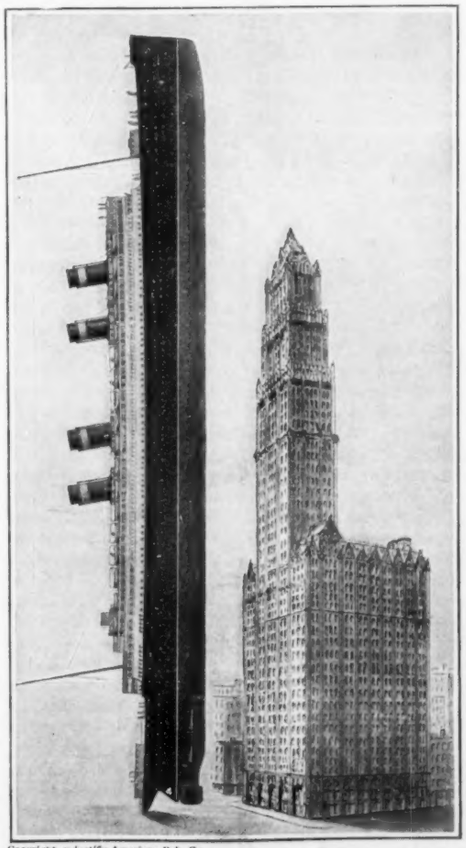
Plans for the two gigantic oil-burning ocean racers designed for a speed of 30 knots and capable of crossing the Atlantic in less than four days have been completed, and as the result of the conference had between Chairman Hurley, the Chief Constructor of the Navy, and the presidents of the big shipbuilding yards, a formal communication was addressed to the Secretary of the Navy, recommending the immediate appointment of a committee to supervise all details of this great undertaking.

The Shipping Board long ago had in mind the building of two passenger liners that would exceed in size and speed any merchant vessels under any flag. But while the war was on it felt reluctant about taking the matter up. Now that peace has been signed, it means to go ahead with the plan and to begin work on these two vessels without delay.

An unique departure from the usual procedure is the recommendation contained in a letter to Secretary Daniels, and in which Chairman Hurley asks the Navy Department to supervise the building of these vessels—a logical thing to do, however, as they would be classed as Navy auxiliaries, the Shipping Board paying all expenses in connection with their construction.

The contracts will carry a time limit in which the ships are to be completed; and, in order to stimulate rivalry between competing yards, a bonus plan is being worked out. The Navy habitually pays a bonus for speed in excess of contract, but the Shipping Board feels confident that the enormous speed required for these racers will be fully sufficient for the service for which they have been designed. Therefore, it is more concerned with speedy delivery than with the extra knot or two which might be added to their pace. So its contemplated bonus is for delivery ahead of contract, rather than for speed in excess of contract.

Each of these gigantic ships will measure 1,000 feet in length, as already stated. This is 50 feet longer than the "Leviathan," now the largest vessel that floats. Up-ended, one of these gigantic ships would surpass the Woolworth building, which is 750 feet high, by 250 feet, as shown in the accompanying drawing. The beam of the "Leviathan" is 100 feet; that of the new American liners will be 102. The gross tonnage of the new ships will be 55,000. They are to have a draft of 35 feet, a depth of 74 feet, and are to accommodate 1,000 saloon passengers, 800 second cabin, and 1,200 steerage. The crew will number 1,000 officers and men. The vessels are to be of the oil-burning type. They will be driven by four propellers, upon which will be thrown the strength of 110,000 horse-power.



Copyright, Scientific American Pub. Co.

Up-ended, the 1,000-foot steamer would tower 250 feet above the Woolworth Building

The vessels will be built with a view to converting them immediately into commerce destroyers in the event of war. For this purpose gun emplacements will be built into their decks ready to receive gun mounts and their batteries. The after-deck will also be constructed with a view of transforming it into a landing and launching space for hydro-airplanes.

There are to be ten decks. As these are more numerous than the names usually given to designate the different ones, such as sun deck, main deck, boat deck, etc., no effort will be made to designate the various decks by names. Instead, they will be known by letters—A deck, B deck, etc.

The ships are to be fitted with an inner and outer skin, such as was done with the great White Star liner "Olympic" after the disaster to the "Titanic." Moreover, they are to be divided and subdivided into compartments so numerous as to render them unsinkable.

These oil burners will have a steaming radius of 7,000 miles. This means that they will be able to make a round trip across the Atlantic without wasting an hour's time in renewing fuel. Their design contemplates the carrying of passengers and their baggage, the mails, express parcels, and nothing else. They are, therefore, expected to create a record in the matter of rapid "turn around," as the shipping folks phrase the coming into a slip and the backing away from it.

As for the new port planned at the eastern end of Long Island, the practicability of this scheme is greatly doubted. The idea is by no means new; indeed, it is an ever-recurring one with steamship men. It is argued that by having the new steamers dock at Fort Pond Bay, at the eastern end of Long Island, the trip between Plymouth, England, and New York, would be cut down from 2,996 miles to 2,878 miles. Railroad facilities could be provided for taking care of the passengers debarking at Fort Pond Bay, and the trip would be shortened by 118 miles and eliminate the danger of the loss of from six to eight hours which might result because of unfavorable tides in the Ambrose Channel. The new port would, it is believed, reduce the journey to four days.

It is realized that much expense would be involved in making Fort Pond Bay a steamship terminal. The bay is an indentation of the north shore of Long Island, and while protected from the southeast, south and west, it is exposed to the northwest gales. Army engineers say that in order to protect shipping from seas rolled up by

(Continued on page 168)

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.
Founded 1845
New York, Saturday, August 16, 1919
Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

Copyright 1919 by Scientific American Publishing Co.
Great Britain rights reserved
Illustrated articles must not be reproduced without permission

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Legal Advice with a Guarantee

DOUBTLESS someone will correct us if we err in attributing to Mark Twain the tale of the business man who conceived a plan for making a fortune but was beset by doubt as to how the courts would regard his scheme. So he went to the District Attorney and laid the plan before him in every detail, with a request that he be informed whether it would stand legal attack. The official smiled wisely and told him that to learn that he would have to put the plan into effect, whereupon he—the District Attorney—would prosecute him on the assumption that it was unlawful; and if he were then acquitted, he could assume that his action had been within the law. The interview closed by the prosecutor expressing his sincere thanks for the great aid which the gentleman, by his frank confidence, had extended the Government in the event of court action being necessary.

Now this is not a bit far-fetched. Under current conditions, it is often a matter of great difficulty and expense and even uncertainty to decide whether a given course is lawful or not. When there were but a few people, living under a system of patriarchal justice, it was easy enough to law down the simple canon, "Thou shalt not kill, steal, lie, nor give violence." But as people increase and transactions multiply, complexity also prospers; until every day sees a new insidious way of cheating or doing violence. Then the more people there are, the easier it is to do unintentional injury, and consequently the more things have to be prohibited, not because they are wrong of themselves, but because they are against public policy in the extent to which they react on others. Almost everything one does today may appropriately be examined in the light of its possible consequences to others; and surprising it is how often agreement as to the extent of these is difficult to reach. The number of decisions which our courts reach by a divided vote is earnest of this; unanimity is the exception among professional judges.

For these reasons it is no longer fair to ask a man to search his conscience to tell him whether he is about to do wrong. That, of course, is what present procedure amounts to. It is assumed that any violation of law was intentional, or that it could have been forseen had the will to do this been present. But the fact is that almost any business program which is at all worth while is in danger of running foul of some enactment. If we were to refrain from doing everything which might by any possibility turn out to be illegal, business would be dead in a week. Yet, as in the story, the only way open for the business man to find out whether he is to be a criminal is to try it and see. The thing is reduced to the level of a guessing contest, with penalties for a bad guess.

The American Bar Association has a suggestion which would eliminate all this. It is conceded that at present there is no agency to which one can go for guaranteed advice. You can go to your own lawyer; and if he advises you in accordance with his own opinions, you will, if this advice turns out not to be that which you want, go elsewhere with the certainty that a good lawyer can be found who will tell you what you want to hear. But whatever advice you get, it may be right and it may be wrong; the only way to find out is to get a case into the courts and carry it as far up as it will go.

The Bar Association would have Congress empower some administrative body to determine in advance, on proper application, whether a business agreement or arrangement is due and reasonable, and therefore lawful. The decision thus reached in advance might be permanent and binding; or at least, if it were subject to review and reversal, there would be no penalty attached to having acted under it in the meantime.

Aside from the relief which this would extend to business men in enabling them to initiate large undertakings with greater security against legal impasssé, it would in all certainty relieve the cluttered courts of a goodly portion of their calendar arrears. There would of course be suits brought to reverse the commission's findings; but they would be small in numbers in comparison with present Sherman Law prosecutions, injunction proceedings and damage claims.

Life Preservers for Air Passengers

TRAVEL at sea is one of the safest forms of transportation in existence. For every steamship passenger lost, millions are carried in safety. The chances of fire, of collision, of running on the rocks, or of foundering in the gale are almost negligible. And yet no one would venture forth on a vessel inadequately provided with life saving equipment. In fact, no ship is allowed to leave our ports which does not carry life boats and life rafts of sufficient capacity to accommodate the entire crew and passengers, and a life preserver for every individual on board.

A new ocean is opening to navigation. Since the war, there has been marvelous activity in the development of passenger air service. Europe has a number of regularly established passenger lines served by large airplanes with capacity for a number of passengers. Such lines are now being established in this country as well. Large passenger-carrying dirigibles are being built to run on schedule and also on long distance cruises. In fact it has been announced that some time this month the British passenger dirigible R-80 will sail from Barrow-in-Furness, England, to Rio de Janeiro by way of Lisbon and Sierre Leone. This airship expects to make scheduled voyages, taking four days for each trip, and carrying twenty passengers.

With all this activity in the air it is high time that attention was paid to the safety of the passengers and the crew of these airplanes and airships. Air travel is admittedly one of the most dangerous forms of transportation and the casualties will mount high if the utmost precautions are not taken. It is true that experiments are now being made with parachutes of different kinds and some of the large dirigibles have actually been provided with them. The R-34, which visited us recently, was fully provided with such life-saving equipment. Along the "cat walk" of the big balloon there was a parachute and life belt for each member of the crew, and the practicability of the equipment was demonstrated at Mineola, when a man came down by parachute from the airship and directed the mooring of the giant dirigible. However there was no such provision in the NS-11, the British airship that recently ran into a thunder storm and fell, a mass of flames, into the North Sea. Not a single life was saved in that disaster. The dirigible balloon which fell in Chicago recently and burst into a mass of flames was furnished with parachutes, but in at least one case the parachute failed to open and the man it bore fell to his death.

Less attention has been paid to the safety of passengers on airplanes than on airships. While many experimental parachute descents from airplanes have been made we have yet to read of a passenger plane regularly equipped with such devices. Only the other day, in Italy, a giant Caproni burst into flames while high in the air, and everyone aboard was burned to death, before a landing could be made.

There is no doubt that serious difficulties are encountered in designing a parachute that will operate satisfactorily from an airplane. The parachute must be compact and stowed away where it is not liable to unfold and become intangled in the airplane, at the same time it must be ready for instant use. Means must be provided for attaching the parachute to the passenger without a second's notice and in such fashion that the passenger will not be injured. When the parachute first drops it is in collapsed condition. It takes time for the canvas to unfold. At first there is a sheer drop of 200 feet or more, during which the falling passenger attains a tremendous velocity. When the parachute opens completely the velocity is suddenly checked and the strain on the harness which attaches it to the passenger is very severe. Sometimes the strain registers as high as 900 pounds. Special springs are provided to take the shock; if they are light, they may break and if heavy and stiff the passenger will suffer. The utmost care is necessary in the design of the harness to prevent injury to the passenger. After the parachute has opened the passenger rides on down to earth in perfect safety until the moment of landing. If the air is quiet this should not prove difficult. Parachutes seldom travel more than 15 feet per second, which is about the speed of an object droping from a height of 3½ feet; double this speed would not injure the passenger in landing in still air. However, if the wind is blowing, landing is very hazardous. The parachute acting as a big sail will drag the passenger along the ground and may injure him severely. For this reason the harness must be so arranged that it can be released instantly. The releasing mechanism must be fool-proof and not liable to accidental operation and yet it must function without a second's delay.

It is true that as yet the perfect parachute has not been made, but that is no reason why it should not be used on airplanes. The analogy between the parachute and marine life saving equipment is close. There is first the danger of launching. In a heavy sea boats are liable to be upset. If the vessel is heeled over many of the life boats cannot be launched. After they have been launched successfully, if the wind is high there is the danger of wreckage while landing on a stormy shore. Although these difficulties of a marine life saving apparatus have not been overcome and although the perfect launching mechanism for life boats is yet to be developed, no one argues that ships should not be equipped with life boats. Similarly the fact that the perfect parachute has not yet been developed is no reason why the best parachute we have so far should not be required by law on all our airplanes, with the further requirement that it be superseded by better ones as better ones are invented.

The Camera—A Super-Reporter

JOURNALISM owes a great debt to the photographer. Indeed, it is but a few years ago that the news photographer was unheard of, and the camera was more or less regarded as a purveyor of portraits to the family album, which adorned the sitting-room table of most homes. But today the camera has attained a high position in the field of journalism, for it is realized that there is no quicker or better way to tell a story than in the photographic language.

The accuracy of present-day photographs is truly remarkable. For instance, long before the end of the war, Americans were familiar with tanks, big guns, steel helmets, and other equipment of modern warfare—without having seen them. The big dirigible, R-34, had been illustrated in many of our newspapers and periodicals, long before she started on her trans-Atlantic voyage. Inventions big and little have been photographed long before their introduction to the public.

Somehow or other the photographs acquaint one with a subject or article long before one actually sees said subject or article. Thus tanks, big guns, steel helmets, and other things seemed quite commonplace when they come to us in actual form, following the signing of the armistice. Persons who saw the big British dirigible R-34 on Long Island were disappointed, because it was exactly as the photographs had depicted many months before. Inventions are immediately recognized when they are placed on the market. All of which means, of course, that the camera is a wonderful reporter both as regards accuracy of detail and range of appeal.

To Our Subscribers

OUR subscribers are requested to note the expiration date on copies of SCIENTIFIC AMERICAN. If they will send in their renewal orders at least two weeks prior to the date of expiration, it will aid us greatly in rendering them efficient service.

Automobile

Storage Batteries Need Constant Attention.—If the car is driven to any extent, special attention should be given the storage battery as this is apt to be damaged unless the cells are kept properly filled with distilled water. The acid is driven into the plates due to the discharging process and some of the water of the electrolyte evaporates due to the heat. As the supply of acid is not reduced appreciably, it suffices to replenish the water supply. Storage battery cells should be inspected every week during the summer.

Grease on Brakes.—Another condition that is the result of warm weather is the leakage of grease from rear axle interiors and the attendent excessive deposits of that material on the brake drums, especially on the inner periphery against which the emergency or internal brake bands act. This reduces braking efficiency to a considerable degree and wherever such deposits are found, they should be removed by cleaning the parts thoroughly with gasoline, even if this should necessitate removing the wheels to gain access to the brake drum interior. The leakage is usually caused by the thinning out of the grease due to high operating temperatures in the axle interior.

Magnet Recharging.—The permanent field magnets used on magnetos are easily recharged by inserting them in solenoids wound for a current of 20 amperes at a potential of 6 volts so they can be coupled up to an automobile starting system battery of that voltage. The connection is made only for an instant as several contacts of a second's duration are all that is needed and this will not injure the battery. It is stated that a freshly charged tungsten steel magnet of a large magneto will lift in the neighborhood of 20 lbs. as ordinarily energized. This may be tested by a spring balance attached to a suitable armature member. In some cases where the magnets are large, the pull may be as high as 30 pounds.

Testing Mica Insulated Spark Plugs.—Plugs using mica insulation are very deceptive, as in many cases short circuits exist that cannot be detected by the eye in daylight. A good way to test a suspected mica plug is to lay it on top of the cylinder after dark, taking care not to have the insulated terminal in contact with any metal parts except the high tension current lead. The engine is then run on the other cylinders and the inside of the spark plug watched to see if sparks jump between the insulator and the plug body, instead of between the points. If a short circuit exists, it will be easily detected by the minute sparks plainly evident in the darkness. It is sometimes possible to test a plug out in the daytime by shading if trom the light in some manner, as with a black felt hat.

Starting System Precautions.—Never run the car with the storage battery disconnected, or while it is off the car without consulting a competent electrician. Very serious damage to the motor-generator may result from such action in certain systems. Never remove any electrical apparatus from the car or make any adjustments without first disconnecting the storage battery. This can be done most conveniently by removing the ground connections. This will prevent harmful short circuits, especially in the one-wire system if a circuit is completed between the frame and current supply wire by a metal tool. This is an important precaution to observe at all times but especially when working around the starting motor circuit. Remember, a loose, corroded or dirty connection on the battery can put both starting and lighting systems out of commission.

Shuttered Radiators in Warm Weather.—Many of the newer automobiles have that type of radiator to which shutters are attached so the amount of air passing through can be regulated, either by automatic thermostatic control or by hand through a suitable rod or lever on the cowl board. During warm weather, if the motor heats up unduly care should be taken that the shutters are wide open as sometimes they may be inadvertently closed, either wholly or partially and as the air flow through the radiator is reduced, the cooling water soon heats to the boiling point. Another point to check up is the tension of the fan driving belt. This must be kept tight enough to drive the fan positively at all times but more especially in the summer when all the air that can pass through the radiator is needed for keeping the water temperature within bounds.

Science

The French Association for the Advancement of Science, which suspended its annual meetings during the war, is now plannning to resume them with a meeting at Strassburg in 1920.

The British Imperial Antarctic Expedition.—The personnel is now being selected for this expedition, which is to sail next June under the leadership of Mr. J. L. Cope and is expected to be absent six years. The scientific staff will be headed by Robert C. Mossman, a veteran on antarctic meteorology, who was a member of the Scottish National Antarctic Expedition and was subsequently attached to the Argentine Meteorological Office. Captain Hurley, who was the photographer of the Mawson expedition and served as an official photographer with the Australian forces during the war is to go with the new expedition as photographer. Mr. Ernest Joyce, who was with the Scott and Shackleton expeditions, is in charge of organization in Australia and will probably accompany the expedition. Mr. Cope will take an airplane with him and hopes to fly to the south pole.

Attacking the Seed-Beds of Yellow Fever.—The International Health Board (Rockefeller Foundation) continues to wage relentless war against yellow fever in the parts of the world that are regarded as the seed-beds of this disease. It is hoped that by this radical plan yellow fever may eventually be altogether eliminated from the world. An epidemic was reported in Guatemala in June, 1918. The Board despatched Dr. Joseph H. White to the scene, and an energetic campaign was organized, resulting in freeing Guatemala from the disease in a few months. Late in the year a corps of 125 men was put to work destroying Stegomyia mosquitoes in the city of Guayaquil, Ecuador, for the purpose of ridding that city of yellow fever. Since last November the yellow fever work of the International Health Board has been directed by General Gorgas, late surgeon-general of the Army.

Mountain Meteorological Stations in Europe, as they were before the war, are described in a recent number of *Naturwissenschaften* by Prof. F. Klengel. Of the 21,500 stations in operation in the various European countries, 660 were more than 1,000 meters above sea-level, about 150 more than 1,500 m., 44 more than 2,000 m., eight more than 2,500 m., and one, the Sonnblick observatory, above 3,000 m. The observatory of the Sonnblick (3,106 m.) is the highst meteorological station in Europe that is in operation the year round, but there are still higher stations that remain open a few months each year; *e. g.*, the Vallot observatory on Mont Blanc (4,358 m.) and the Regina Margherita observatory on Monte Rosa (4,560 m.). These very lofty establishments are inaccessible in winter, but are used for various scientific investigations in summer. The above enumeration of lofty stations does not include a large number of seasonal snow-gages, or so-called "totalizers," which have been installed on an extensive scale in the Alps by the Swiss meteorological service. These gages are visited once a year, when the gage is emptied and its contents measured.

The Surgeon-General's Library and Museum.—The library of the Surgeon-General's Office, U. S. Army, is, with one or two exceptions, the finest medical library in the world and it offers rare opportunities for study to physicians who live in or visit the capital, especially by virtue of the unlocking of its treasures through the monumental Index-Catalog and the Index Medicus. It is housed with the Army Medical Museum, also an admirable accessory to research in medicine and kindred subjects. The building containing these institutions, though overcrowded, is conveniently located in the heart of Washington. Most users of the library and museum will learn with consternation that provision has been made in the current Army Appropriation Bill for buying a tract of land in an outlying suburb of Washington, adjacent to Walter Reed Hospital, and that both establishments, as well as the Army Medical School, are eventually to moved thither. A few years ago the War Department moved its splendid military library from the central location of the State, War and Navy builings to the remote Army War College, where it is quite inaccessible except by automobile. Now the Surgeon-General's Library is to banished to an even more distant "jumping-off place."

Industrial Efficiency

Packing of Crude Rubber for Shipment.—A rather important change in the manner of handling crude rubber in the Far East has been made in the new general custom in the trade to pack the product in bales for ocean shipment instead of in the comparatively loose packages in which it has been shipped heretofore. The practical effect of the new method is to reduce the bulk of the product packed for shipment by about half and on the average to cause its weight to approximate its bulk in ship's ton measurement, *i.e.*, 2,000 pounds of rubber baled occupies substantially 40 cubic feet. In shipping this has the effect of classifying rubber as heavy cargo instead of light cargo and materially affects the nature of shiploads leaving the various Far East rubber exporting ports.

The Belgian Window-Glass Factories did not, in general, suffer very much from the German occupation, and would have been able to operate very quickly after the armistice if there had not arisen very great difficulties in transportation, which brought about a shortage of food and raw materials. The last of February and in March two factories started up—one of which uses the old process of glass blowing by hand, and the other produces by means of machines. The other Belgian factories are very anxious to begin operating, but they have had to deal with very great difficulties in regard to labor. The workmen demand not only very high wages but also certain new conditions under which they are to work—and it has been very difficult to come to an agreement

A Degree in Commerce.—The plan of the University of London to grant degrees in commerce is attracting much attention. Under this scheme it is proposed to grant the degree of bachelor of commerce to candidates who pass the necessary examinations after a three years' course of study. Those who so desire may later proceed to the degree of master of commerce, after a minimum of two year's practical experience in the particular trade or industry taken up. The foundation and maintenance of this new course of study is expected to involve an annual expenditure of $108,750, necessitating the provision of a capital of $2,175,000. The scheme has the warm support of representative men in the world of commerce, and business men are being urged to contribute liberally in order that the necessary sum may be raised quickly.

British Land-Reclamation Scheme.—The British Board of Agriculture has inaugurated a scheme for the reclamation of land on the Lincolnshire shore of the Wash. A bank is being constructed from Wainfleet, a little below Skegness, to Freiston, near Boston (Lincolnshire), commencing at the Wainfleet end, and by this means it is hoped to recover about 12,000 acres. The work is in charge of a resident engineer in Wainfleet and will employ a large number of men, who will be selected from demobilized soldiers and sailors, and thus obviate the taking away of labor from agriculture. It is said that in the middle of the last century a reclamation scheme was started, and it was then estimated that sufficiently large area would be redeemed from the Wash to form a new English county. The enterprise was abandoned, but experts have always maintained its practicability, which is now in the course of being tested.

Merits of Rubber Seed for Oil and Cattle Food.—There has been considerable discussion during the past year or two concerning the utilization of Para rubber seed for oil, and it is stated that already exhaustive experiments have been made along this line. It is cited that in one instance oil from rubber seed was sold at about $250 a ton at a time when the price for linseed oil stood at $300. Experts are of the opinion that this oil could probably be successfully used in the manufacture of paints and varnishes, linoleums, soft soap, rubber substitutes, etc. In addition to the use of rubber seed for the purpose above mentioned, it is stated that experiments conducted in the Straits Settlements have clearly shown that a feeding cake for cattle and other stock, favorably comparing with linseed and other oil cake, can be produced from the residue of the Para rubber seed, after the oil is extracted, thus affording an opportunity for the development to very considerable proportions of a profitable industry in connection with the ordinary oil extraction.

A Salvaging Submarine

Describing the Latest Craft of Simon Lake Which Simplifies Underwater Work

By Hawthorne Daniel

THE submarine is essentially an American production, and Simon Lake, who has had a very great deal to do with the development of underwater craft, has recently finished the construction of a new type of submarine, designed for salvaging and underwater construction work, that seems to be a long step toward making such work easier and more successful. This outfit, which incorporates several new ideas, seems readily capable of performing work that has hitherto been practically impossible of accomplishment.

I had heard some whisperings of this ship, and when I was given an invitation to be the first person not connected with the work, to make a descent in it, I immediately seized the opportunity. It was on July 12th that I went to Bridgeport, Conn., to see the submarine, and that afternoon I was initiated into the mysteries of submarine salvaging by the new method.

To be exact the ship is not a submarine at all, but is a combination of surface vessel and a new kind of diving bell, so arranged that whether the diving bell is submerged or on the surface workmen can readily pass from the surface vessel to the bell, and vice versa.

The surface vessel is a large scow—something of a houseboat—on which are the quarters for the crew, the engines, generators, and navigating equipment. From the bow of this scow extends a pipe, 4½ feet in diameter and 75 feet long, with the inboard end turned at right angles to the pipe itself, and projecting about 4 feet above the level of the deck. This pipe is hinged so as to allow the outer extremity to describe an arc of 60 degrees from the surface of the water down, and to the outer extremity is hinged the diving bell or submarine, which submerges or rises to the surface on an even keel. The pipe, as it is now constructed, is comparatively short, but it is thought that no structural difficulties will be encountered in making it as much as 300 feet long.

In the operating chamber of the Lake salvaging submarine, at a depth of 20 feet

To prevent any lateral movement, cables are rigged to several points along the pipe, and these are carried to the port and starboard sides of the blunt bow of the houseboat at the center of which the pipe is hinged in a recess constructed to receive it.

The submarine or diving bell is submerged by allowing water to enter specially constructed tanks until the reserve buoyancy is overcome, and the depth to which it is to be sunk is regulated by cables running over a framework built out over the bow of the houseboat and made fast to the tube about half way from the houseboat to the diving bell.

The tube, when on the surface, is difficult to pass through, because of its limited diameter, but as the submarine submerges and the tube is inclined, it becomes easier to enter or leave it, the tube being fitted with a series of angle iron cleats to serve as steps. The whole apparatus is electrically lighted, and the wires and the compressed air pipes run the length of the tube inside, where every foot of them can be readily inspected or repaired.

When I reached this strange combination of surface vessel and submarine, in company with Mr. Lake, the submarine was on the surface, and the top of the connecting tube, which was eight or ten inches out of the water, could be used as a runway from the houseboat to the submarine. The whole apparatus did not look unlike a dredge, as it lay at anchor, and to a person only casually observing it from some passing boat it presented no extraordinary features. But from the forward deck of the houseboat, with someone to explain them, a number of unusual features became apparent.

Immediately after we came aboard Mr. Lake ordered the crew to submerge the submarine, and two men scrambled into the upturned end of the tube, disappearing one after the other, and shortly the submarine and the outboard end of the tube slowly settled in the water, gradually disappearing beneath the surface. A telephone connecting the submarine with the bridge of the houseboat rang and one of the men in the submarine announced that they had reached the bottom, and were resting on the sand. The submarine was ordered to raise about a foot, and when the cables over the framework at the bow were set taut the submarine was brought to the surface, and Mr. Lake informed me that we were ready for a trip.

The submarine was again submerged, and following Mr. Lake I climbed through the tube, which was inclined at an angle of 25 or 30 degrees. Reaching the end of the tube we passed through a small round door into a "compression" chamber. This door is constructed at the joint between the tube and the submarine. The end of the tube is built like a T pipe and fits into a recess in the submarine. It is at each end of the arms of the T that the joints occur, and also at these points are the small watertight doors. The accompanying diagram shows how the tube and the submarine are connected.

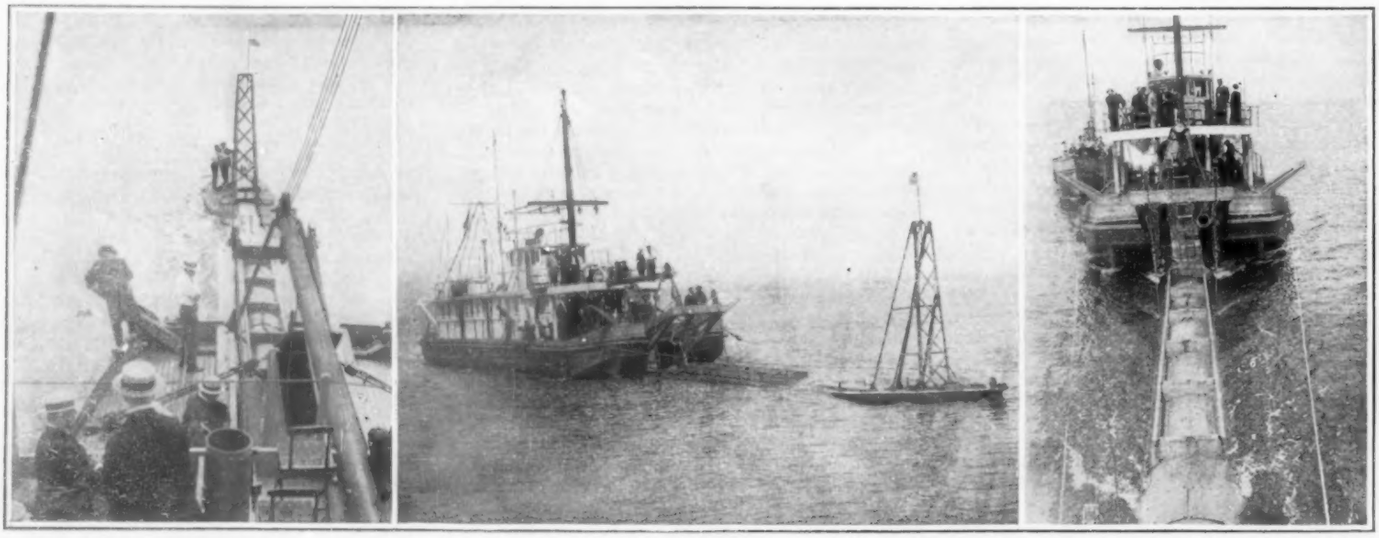
Passing through the small "compression" chamber we entered the operating chamber, which takes up most of the space in the submarine, which is only about 20 feet long and 8 feet wide, with a little over 6 feet head room. The two men who had preceded us were sitting patiently in a corner smoking when we arrived, and as soon as the airtight door had been closed behind us a valve was turned on, and compressed air hissed into the chamber, causing a sensation in my ears similar to that experienced in going into the tubes under the Hudson.

"Swallow," suggested Mr. Lake, and for several minutes I continued to swallow, equalizing the pressure outside and inside my eardrums. One of the men opened a small petcock that was connected with a short pipe running through the bottom of the submarine, and shut it off when the water spurted through.

"Not enough yet," he remarked, and the air valve was opened a little wider.

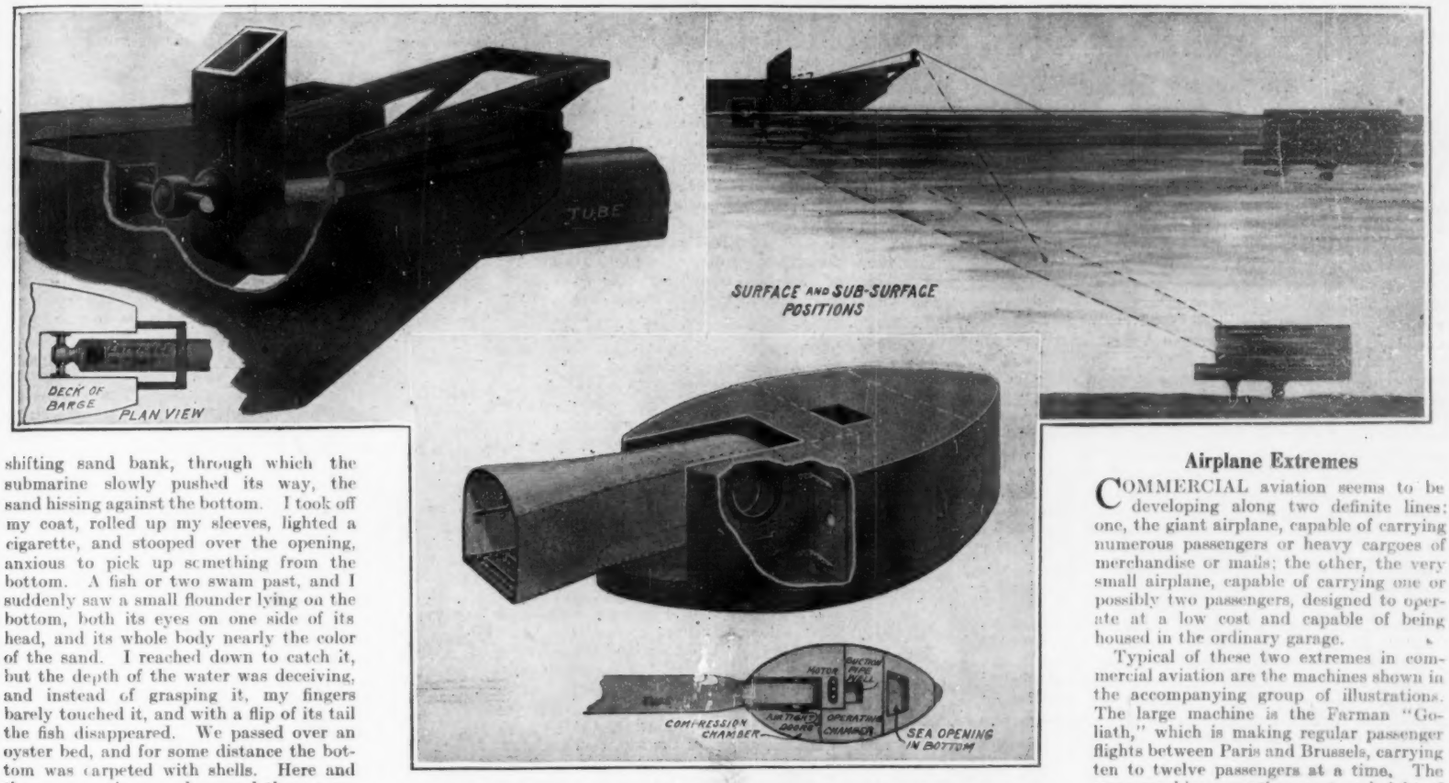
Again the petcock was opened, and the water, which bubbled in at first, finally stopped. The air was shut off and with a big wrench the man set about opening a trap door in the bottom. Loosening several nuts he pushed the trap door, which measures about 3 feet fore and aft by 5 feet wide, out of sight beneath the boat, and there was the water, held at a level even with the bottom of the boat by the compressed air.

An order from Mr. Lake was telephoned up to the bridge, and we began to move, with the bottom about a foot below us, and clearly visible through the green water. Sometimes it dropped away, and disappeared in several feet of water, and once we ran onto a small



At the left: Aboard the scow and looking toward the submarine. *Center:* The scow and the submarine which go to make a salvaging unit. *At the right:* Aboard the submarine and looking toward the scow, showing the connecting tube in the center foreground

A collection of views of Simon Lake's salvaging submarine in operation in Long Island Sound



At the left: How the submarine tube is hinged to the scow. *At the right:* Schematic arrangement of the submarine when in the surface and sub-surface positions. *Center:* Details of the submarine.

Details of the Lake salvaging submarine

shifting sand bank, through which the submarine slowly pushed its way, the sand hissing against the bottom. I took off my coat, rolled up my sleeves, lighted a cigarette, and stooped over the opening, anxious to pick up something from the bottom. A fish or two swam past, and I suddenly saw a small flounder lying on the bottom, both its eyes on one side of its head, and its whole body nearly the color of the sand. I reached down to catch it, but the depth of the water was deceiving, and instead of grasping it, my fingers barely touched it, and with a flip of its tail the fish disappeared. We passed over an oyster bed, and for some distance the bottom was carpeted with shells. Here and there was a tin can—here and there some shapeless bit of metal, long beneath the surface. The water got a little deeper, and a telephone message to the bridge lowered us a couple of feet, the water pushing into the well, which is built around the opening, for two or three inches. To counteract it the air was turned on again, and the water receded. We passed the depression, and scraped the bottom, and another message to the bridge raised us, while the excess air escaped through the opening, and darted in a myriad of bubbles to the surface past the tiny glass ports in the side of the submarine.

I opened my camera, which I had brought with me, and took two flashlights, and the compressed air was turned on to clear the atmosphere of the smoke of the flashes. Mr. Lake watched my preparations carefully.

"I believe," said he, "that those pictures are the first flashlights ever taken in a submerged chamber with the door open to the sea."

We were submerged for over an hour, and the entire apparatus was carefully explained to me. On the bottom of the submarine there is fitted a wheel, operated by an electric motor in a small separate compartment. This wheel can be used on a hard bottom, to propel the vessel, and a small steering wheel is fitted to guide it. I did not see the wheel in operation as the bottom over which we traveled was too soft and yielding to give traction.

There is a square opening, about one foot on each side,

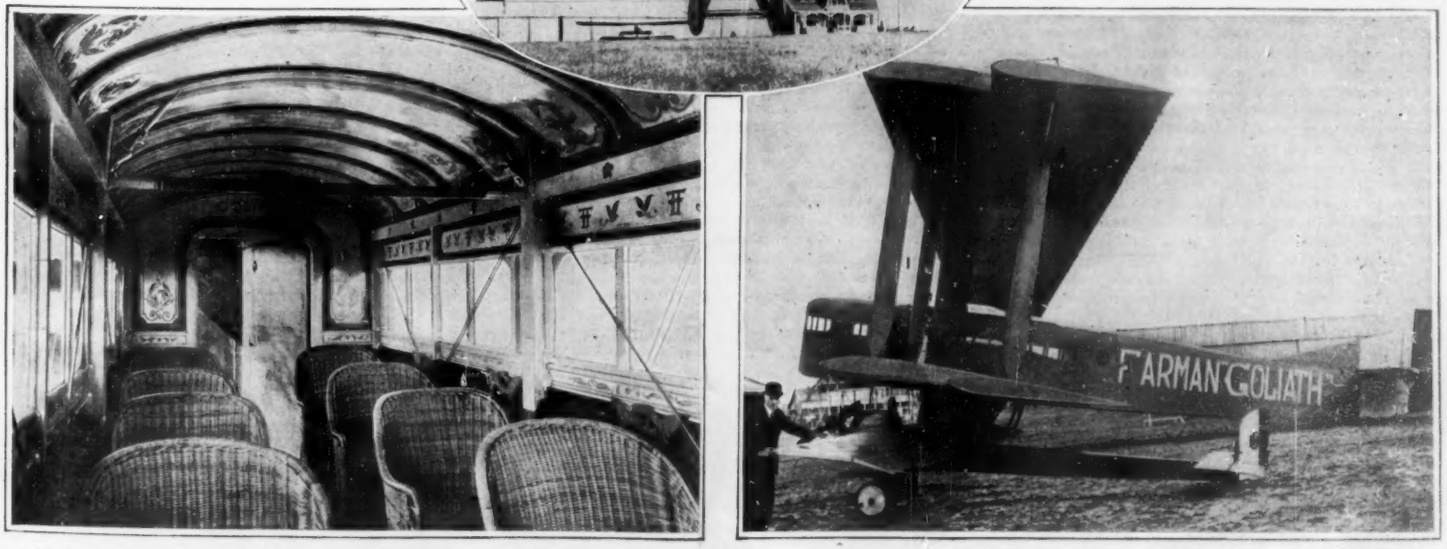
(Continued on page 166)

Airplane Extremes

COMMERCIAL aviation seems to be developing along two definite lines: one, the giant airplane, capable of carrying numerous passengers or heavy cargoes of merchandise or mails; the other, the very small airplane, capable of carrying one or possibly two passengers, designed to operate at a low cost and capable of being housed in the ordinary garage.

Typical of these two extremes in commercial aviation are the machines shown in the accompanying group of illustrations. The large machine is the Farman "Goliath," which is making regular passenger flights between Paris and Brussels, carrying ten to twelve passengers at a time. The same machine recently rose to a height of over 10,000 feet with its full load of passengers. It makes a speed of close on to 100 miles an hour, when operating its two 250-horse-power radial engines. In a recent flight one engine broke down, yet the machine was able to continue its flight with the remaining engine, proving the practicality of the multi-engined plane for commercial purposes.

The other machine is the Farman "Mosquito"—a diminutive single-seater monoplane equipped with a two-cylinder engine of about 20 horse-power. The "Mosquito" is meant to be a sport machine. It is small enough to be readily stored in the average garage. Its upkeep is a simple matter, because of the simplicity of its construction. It makes a speed of about 65 miles an hour, and lands at a speed of about 25 to 30, so that it can start or land on an ordinary road, if necessary. In flight, however, the little "Mosquito" does not possess the stability of the larger airplanes. It pitches and swerves from side to side, which would seem to indicate that the pilot must be constantly on his guard in order to avoid accident.



At the left: The cabin of the Farman "Goliath," showing the comfortable wicker seats, large windows, and more or less complete absence of the usual maze of guy wires that goes with airplanes. *At the right:* The "Goliath" and the "Mosquito" side by side—a contrast in commercial aviation. *In the oval:* The "Mosquito" in flight, making somewhat over 60 miles an hour.

Extremes in commercial aviation—The Farman "Goliath" and the Farman "Mosquito"

Corrosion-Proof Steels

Recent Progress in the Development of Iron Alloys That Resist Rust

By F. Rowlinson

WITH the vast increase in the use of steel in constructional and engineering work, the problem of its resistance to corrosion has reached a very considerable degree of importance. Years ago, whenever permanence of structure was required, wrought iron was usually specified, because under proper conditions it has shown remarkable powers of resistance to certain forms of corrosion. Thus, for instance, there are in existence wrought iron columns at Delhi and chains at Adam's Peak, Ceylon, which have been proved to have been in their present state for thousands of years, notwithstanding the influence of atmospheric corrosion. This characteristic of wrought iron seems to be due rather to a physical property resulting from the method of manufacture than to any chemical powers of resistance possessed by the metal itself. The manufacture of wrought iron results in a "fibrous" structure, really of attenuated crystals, each surrounded and insulated by a protective coating of slag. It is to this slag that the iron owes its powers of resistance. But wrought iron is a costly or otherwise unsuitable material for most of the work for which corrosion-proof steel is required, and the development of steel alloys has opened a vast door to the experimenter who seeks a corrosion-proof metal.

The materials now in use naturally divide themselves into two classes: Those where strength and a fair measure of resistance to corrosion are of importance, but where cost also has to be comparatively low. The second class includes those alloy steels in which the question of freedom from corrosion is of primary importance, and that of cost negligible in comparison.

Nickel Steels

All steels used in building and constructional work would, of course, be better if they could be made of corrosion-proof materials. The large quantities of steel used in modern construction have raised serious doubts as to the permanency of these structures. So that, wherever long life is desirable under more than ordinarily corrosive conditions, alloy steels are now in fairly common use. The first of these to attract notice was nickel steel. It was found that the presence of nickel in steel, while raising the mechanical properties of steel to a very valuable extent, conferred also upon it an increased resistance to corrosion. Figures by Prof. Howe have shown that, taking the corrosion of wrought iron as a standard, the average corrosion over a year's exposure to sea water, fresh water and general atmospheric conditions was as follows:

Wrought Iron	100
Mild Steel	103
3 per cent Nickel Steel	77
26 per cent Nickel Steel	31

The three per cent nickel steel proved more resistant to atmospheric corrosion than to that of sea or fresh water. So that the use of this material is growing where increased strength and resistance to corrosion outweigh its higher cost. The 26 per cent nickel steel is, of course, ruled out of court for all ordinary purposes, but for use in cases where the weight of metal is small in comparison with its importance, it has proved of great value. Instances of its use occur in scientific instruments, measuring tapes, and in non-corrodible fittings for automobiles, etc. Still higher percentages of nickel are often introduced; for instance, a 30 per cent nickel steel has proved in practice to give a life to marine boiler-tubes three times that of plain steel. Nickel steel of this content may be drawn out into wire just as easily as plain steel; wire of this class has been prominent during the war as torpedo protection and in connection with various anti-submarine devices where its high tensile strength and toughness, combined with its freedom from corrosion, have rendered it of the utmost value. Invar, an alloy of steel with 36 per cent of nickel, is exceedingly non-corrodible, and this coupled with the property of an extremely low coefficient of thermal expansion has led to a widespread use in scientific apparatus.

Copper Steels

For many years the presence of copper in steels was looked upon with high disfavor by almost all steelmakers and users. Investigations by Howe, Colly, Müller, and Stead, to name but a few, have repeatedly demonstrated the fallacy of these beliefs, but until very recent years their conclusions have been ignored. Recently, however, opinion has somewhat changed, and now there are several firms who make a specialty of copper steel sheets containing from one to three tenths of one per cent of copper. Comparative tests show that these sheets are more resistant to corrosion than the corresponding plain steels. Where copper is added to steel, the effect seems to be to increase the tensile strength without seriously affecting the elongation and contraction of area. But when the addition exceeds 0.75 per cent segregation of the copper sets in, with disastrous results. Up to that point the copper goes into solid solution with the free iron—above that point copper segregations are found.

Nickel-Copper Steels

Since it was found that both nickel and copper gave immunity from corrosion when added to steel, it was expected that a steel containing both would also be comparatively free from corrosion. This was found to be the case. But an additional feature was found to be present in the more complex steel so made. Providing the proportion of nickel to copper was never less than five to two, the copper does not segregate as it tends to do in carbon steel. In this way the copper content, and, therefore, the powers of resistance to corrosion may be very considerably increased. Moreover, as regards mechanical tests, the copper seems to replace perfectly an equal percentage of nickel, so that a nickel-copper steel with, say 2½ per cent nickel and 1 per cent copper has the mechanical properties of a 3½ per cent nickel steel, with increased immunity from corrosion.

This variety of alloy steel has aroused considerable interest in Canada, where the nickel-bearing ores consist chiefly of iron sulphide with smaller quantities of nickel and copper sulphides, associated with a considerable quantity of siliceous gangue. During the refining process used in the extraction of the nickel and copper, large quantities of waste slag are produced, consisting of iron silicate, with smaller quantities of nickel and copper retained from the ores. It is proposed to manufacture a nickel-copper steel from this slag by reduction in a blast furnace and subsequent refining in electric refining furnaces. A consideration of the electrochemical properties of nickel, copper, and iron indicates that no nickel or copper would be lost in the process, and the copper and nickel now wasted would be recovered without further alloy additions as the valuable nickel-copper steels.

The properties of the steel are such as to render its future use in structural, and particularly in marine work, of vast possibility. The new steel is stated to resist sea water 20 times longer than plain steel, and to be even more resistant to the action of dilute acids. It seems probable that, as soon as the prejudice which as yet handicaps any steel containing copper has been removed, nickel-copper steel will come very much to the fore. It can be produced at a cost not much above that of a carbon steel, and certainly below that of the corresponding nickel steel in which the nickel has been added artificially to the molten bath.

Chromium "Stainless" Steels

While conducting experiments in search of a non-erodible steel for use in the lining of guns, Mr. H. Brearley, the eminent British metallurgist, discovered that a steel containing from 12 to 14 per cent of chromium was possed of quite remarkable properties as regards its resistance to corrosion. The Sheffield steelmakers immediately took up this new material, and from it was made the "stainless" cutlery which achieved popularity even prior to the war. This remarkable alloy steel, while not inferior in mechanical properties to plain carbon steel, possesses not only non-corrodibility under the action of weather, and of fruit juices and other dilute acids, but it is in a high degree resistant to wear by erosion and scaling at high temperatures. The new chromium steel is said to resist corrosive influences, even better than the 26 per cent nickel steel described above; in addition it may easily be softened for machine purposes, and afterward hardened. The high nickel steel is difficult to machine, even when soft, and will not take a high degree of hardness, at all events by such processes as are applicable to finished articles. The immunity of chromium steel to erosion is exceedingly marked, more particularly at high temperatures, and it is now in use with complete success for exhaust valves for internal combustion engines, and for turbine blades. Its adoption may possibly do much to aid the development of the internal combusion turbine—a machine of future possibilities, but which hitherto has met with more difficulties than success. Cutlery of all kinds may be made of so-called "stainless" steel; the benefit this application alone will confer upon the busy housewife is incalculable. A most stringent test may be applied to this steel—that of allowing a few drops of commercial vinegar to evaporate at ordinary temperatures upon the blade. The absence of even the faintest mark is a very definite indication of its stainless properties. During the war the manufacture of "stainless" cutlery has been severely curtailed, since the greater part of the output of this steel was used in the manufacture of special parts for aircraft. But now we may expect to see the "stainless" cutlery again on the market. The application of this chromium steel to general engineering purposes is spreading rapidly to every problem where the greatly prolonged life offsets the increased cost. Machine and engine parts such as pump rods, hot punches, acid pumps for chemical plant, water meters, roller bearings, etc., are now made with conspicuous success of this chromium steel. It is noteworthy that while the manufacture of this steel is patent-free as regards Great Britain, the inventor has taken out patent rights in almost every trading country. The United States patent rights are vested in a syndicate which is not a manufacturing company, but which exists for the granting of licenses and for the advising of licensees. It is also worthy of note that the syndicate proposes to establish a mark, and to accept a fair measure of responsibility for goods sold under that mark even though they be made under license.

A note as to the importance of the physical and mechanical conditions necessary to insure immunity from corrosion may not be out of place here. Although, of course, the chemical composition of a steel has the farthest reaching influence upon its powers of resistance to corrosion, it must be remembered that steels which under optimum conditions are practically non-corridible, may under unfavorable conditions yield results very little superior to plain steels. It is well known that steel may be "strain-hardened," and this pseudo-hardness or springiness is often given to steel articles by a process of forging or rolling at low temperatures. Such steel is quite unreliable as regards its powers of resistance, and in the case of many special steels such treatment will vitiate any desirable results of chemical composition. Where this cold working has been carried to an excessive degree, so that the internal structure of the steel has broken down, and the formation of "slip-bands" and amorphous intercrystalline layers has commenced, corrosion takes place readily. For instance drillings or turnings of any variety of corrosion-proof steel will rust rapidly, and surfaces which have been machined at high speed with the deep cuts used on modern machines are also subject to corrosion. It, may, therefore, be taken as axiomatic that any steel article required to show immunity from rust or corrosion should preferably not be worked in the cold state, or should have a final heat-treatment (either annealing or hardening, according to the class of steel and the service required of it) calculated to remove internal and surface strains. Where heat treatment is not possible after machining, it is imperative that the finishing cuts should be as light as possible, that grinding should follow the rough machining, and that polishing should be the final process. It is well recognized that the crystalline structure of a metal is far less profoundly modified by grinding than by cutting, and that polishing differs radically from either process. Grinding, even if the particles of the abrasive are extremely small, must of necessity produce a multitude of minute parallel channels in the material, each channel surrounded by a strained and distorted structure due to the forcible removal of multitudinous small portions of metal. Polishing, on the other hand, actually fills up these abrasions by inducing a flow in the solid metal precisely as if it were a very viscous liquid. This phenomenon is well known to micrometallurgists, who frequently find that the polished surfaces of their specimens, apparently free from grinding scratches, are badly marked when the "flowed" layer has been removed by some etching reagent. Hence, a ground and polished surface is advisable where greatest resistance to corrosion is sought after. The freedom of such a surface from mechanical starting-places for the commencement of corrosion also confers upon them some immunity.

Freedom from erosion and scaling, on the other hand, seem more dependent upon the chemical properties of the steel. Erosion would seem to be a joint function of scaling and hardness at high temperatures. It is of course impossible that a surface undergoing erosion should be free from crystalline distortion, or that the surface of a metal at scaling temperature should be "clean." Nickel steels of 26 per cent nickel content, tungsten and high speed steels, and high chromium steels seem to be most resistant to scaling, and the latter to erosion at high temperatures.

The Standardization of Standards

A Permanent Body Looking Toward Consistency and Workability in Engineering Dicta

IN many lines of engineering much excellent standardization work had been done before 1917. Our participation in the war emphasized the importance of this sort of thing, and showed most clearly the need of coöperation to prevent the confusion caused by the promulgation of overlapping standards by independent bodies. During the emergency the Government Departments coördinated these efforts in certain lines and greatly assisted in unifying them. In fact, the showing was so good that the various national engineering societies, recognizing the value of what has been done, invited the Government, through the Departments of War, Navy and Commerce, to appoint representatives to act with the societies in continuing this work. The body so formed was the American Engineering Standards Committee.

The definite formulation of the objects of this body, and the arranging of methods for accomplishing them that would be effective without in any way interfering with the many organizations that were already doing good work in this direction, have consumed considerable time. It is only now that the Committee has completed and adopted a revision of its Constitution, which in the beginning was confessedly a provisional document. This revision has been forwarded to the governing boards of all the Federal Departments and all the societies represented on the Committee, with a request for its ratification.

As more fittingly indicating the scope of the work to be undertaken and the interests involved, the new Constitution alters the name to American Engineering Standards Association. It lays down as the objects of the Association the unification and simplification of the methods of arriving at engineering standards; the securing of coöperation between various organizations to prevent the duplication of standardization work; the promulgation of rules for the development and adoption of standards; the reception and approval (or disapproval) of recommendations for standards submitted as provided in the rules of procedure which accompany the constitution (but not the initiation, definition or detailed development of any particular standard); to serve as a means of contact between organizations and individuals interested in the problems of standardization; to work toward an international status for approved American standards; and to coöperate generally with similar organizations in other countries in the promotion of international standards.

Means are provided for increasing the number of representatives in the Association, and as soon as this is approved several important bodies which are now on the outside will be invited to come in. Any organization which has formulated standards may request the Association to approve them, or to approve committees appointed to do standardization work. Such a request, it is emphasized, is entirely at the option of the organization that has formulated or expects to formulate the standard in question.

A good deal of attention is paid to the make-up of committees for the consideration of standards. Whether these are formed by the Association itself, or by the sponsor societies directly interested in the standard under formulation, they must be formed in accordance with certain principles if their findings are to be approved by the Association. If they are to deal with standards of a commercial character, they must be made up of representatives of producers, consumers and general interests, in such a way that no one of these interests has a majority. If they have to do with standards of a non-commercial or scientific character, they must consist of persons specially qualified, without regard to their affiliations.

It is anticipated that in nearly all cases where a new standard is proposed, the approval of the Association will be requested. In case it is considered advisable, the Association is authorized to call a meeting of those who would be interested in the formulation of a new standard or the revision of an old one, for the purpose of selecting one or more sponsor societies. After this the Association will deal only with the sponsor, and will approve the standard only at its request. In all publications a standard will be referred to as that of the sponsor society, followed by the statement, "Approved by the American Engineering Standards Association." The approval may take either of three forms, as recommended practice, tentative standard, or standard, the expectation being that nothing will be approved as unqualifiedly standard until it shall have shown itself to be generally acceptable.

The Association thus acts to bring together those interested in a common object, and when they have completed their work, it will at their request certify that this work has been done in a manner justifying its adoption. Nothing revolutionary is proposed, merely an extension of present practice. The Board of Directors of the Association performs the same functions as the Executive Committee of the American Society for Testing Materials, and the Association as a whole accepts or rejects. It neither selects sponsors, nor considers the subject matter of a standard or the procedure under which it was arrived at—except that it requires sufficient information from the sponsor to indicate that the conclusions are substantially unanimous and that the sectional committee was balanced and representative.

In addition to this work in assisting in the selection of committees and certifying that their work has been done under proper conditions, the Association will act as a bureau of information regarding standardization. It will collect information regarding existing standards and as to the bodies that have formulated and adopted them. This will enable it to give promptly necessary information to those who select a committee to formulate a new standard or revise an old one. It will also enable it to furnish information desired by the working committees regarding what has been or is being done on similar or related lines. It will establish relations with similar bodies in other countries and can do much to promote the acceptance of international standards. It is possible to secure international acceptance of American standards more easily through such a body than in any other way.

With these fundamental restrictions on its activities it may be asked whether there is sufficient reason for the existence of the Association. This naturally has been carefully considered and it is the unanimous conclusion of the committee and of all of those who have been consulted who have been active in standardization work,

(Continued on page 168)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Clouds Formed by Airplanes

To the Editor of the SCIENTIFIC AMERICAN:

I think Mr. E. D. Wells is mistaken in thinking that clouds were formed by airplanes; I think it more likely it was the vapor from the exhaust.

I have seen motor cycles leave a trail of white cloud behind them several hundred yards long. The "sound waves" also I think were smoke rings. Black powder fired from mortars makes very distinct rings, which ascend, and so-called smokeless powder is not absolutely smokeless, but has a faint smoke which, under favorable conditions of light, makes visible rings.

London, England. WALTER WINANS.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of June 7th, 1919, the letter of Mr. Everett D. Wells on the above subject is a very striking proof of the conditions under which clouds are enabled to come into existence. It is a well known fact that drops of moisture will not separate out in dust-free air, even though supersaturated with moisture. This can be demonstrated in a number of ways, the easiest perhaps being to have two glass jars of like size and construction, one filled with ordinary air and the other with dust-free filtered air. When steam is passed into these jars a dense cloud will form in the first but in the second nothing will occur. In the case reported by Mr. Wells the dust had all been removed from the air by the rain of the day before, but a great deal of moisture was still present in an evaporated state and was constantly being increased by the heat of the sun. The exhaust of the airplane engine evidently contained enough dust to form the nuclei of the drops of moisture which constituted the cloud observed.

WM. H. POND.

New York.

To the Editor of the SCIENTIFIC AMERICAN:

I just read a letter by Everett D. Wells, published in the SCIENTIFIC AMERICAN of June 7th, relating to the formation of clouds, due to the disturbance caused by an airplane in flight.

Don't you think that Mr. Wells' theory is rather far fetched? I have just been discharged from the Air Service and while I don't claim to be a second Fonck, still I know a few things about airplanes.

I have noticed this about those "clouds." They can only be seen as distinctly as Mr. Wells says on very still days. And every time a pilot gives his motor a "shot" of oil the "clouds" become more distinct. That is absolutely all there is to it, a wake of smoke formed by burning lubrication oil. I hate to spoil a Medical Corps captain's nice theory in this manner but it hurts to see these humbug stories about the aviation game go uncalled.

W. LEE SANDBERG.

Great Falls, Mont.

Nothing New Under the Sun

To the Editor of the SCIENTIFIC AMERICAN:

I noticed with interest an article on page 13 of the July 5th SCIENTIFIC AMERICAN, by Mr. C. E. Capen, on the method of hitching horses.

It is wonderful how new discoveries of old methods are so often made. This method was in use on the old Erie Canal for years, in towing canal boats. In cruising on the state waters, I have often talked with many of the oldest boatmen about the different ways of towing boats, and I have yet to talk with one who can remember when this method came into use—it is so long ago.

One further possibility which was used by the old boatmen, and not mentioned in this article, is the possibility of using an odd number of horses. By changing the number of sheaves, it is possible to have one horse lead two, hence have a three-horse team, or any odd number.

One obvious point which the author fails to bring out in this article is that the load is evenly distributed among the different pairs of horses.

W. L. MERRILL.

Schenectady, N. Y.

How to Use the Metric System

To the Editor of the SCIENTIFIC AMERICAN:

Reading in the SCIENTIFIC AMERICAN of July 5th, I found a letter from one of your readers stating that the metric system was not well adapted to measures of length. It seems to me that the distinguished reader is not particularly familiar with the use of the metric system, or else he would not have made such a statement. In countries where the metric system is used (and I was in many of them), the *decimeter* does not play a great role, as far as length measure is concerned. It is much more convenient to go by the *centimeter*. Thus, a person is said to be one meter and 80 centimeters in height, and not one meter, eight decimeters. Similarly, 1 m. 85 cm., not 1m. 8.5 decim. The decimeter, of course, comes in very handy where measures of liquids are concerned, as a cubic decimeter equals one liter. I think if the United States wants to capture a large part of the South American trade, it is bound to use the metric system, the English system is arbitrary and cumbersome to all except those who were brought up on it.

M. METLEN.

Chicago.

A Word on Quinoa from An Old Friend

To the Editor of the SCIENTIFIC AMERICAN:

G. K., whose letter appears on page 625 of SCIENTIFIC AMERICAN for June 14th, doesn't seem to be aware that "Quinoa" is already advertised in our seed catalog. I enclose two leaflets which show this. I, myself, grew it some years ago for greens, but not knowing about the seeds, we used all the plants for the table before they seeded. I now have it growing in my garden. The seed is the quickest to germinate of any plant I ever got hold of, and it is a most wonderfully rapid grower. My impression is, as Burbank states it, that it is going to be a wonderful breakfast food, and also that it will have a pretty thorough test during the coming season. As you know, I have been reading SCIENTIFIC AMERICAN since Vol. 1, No. 1. By the way, the article "With Trees for Ears," in the same issue, is worth the price of the year's subscription.

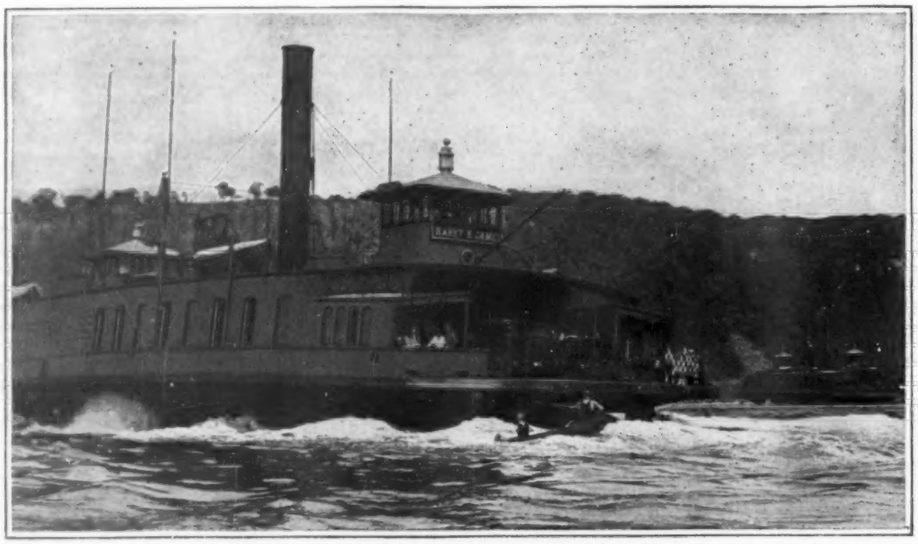
A. I. ROOT.

Medina, Ohio

Coasting in the Wake of a Ferry Boat

A Hudson River Modification of a Hawaiian Sport

PASSENGERS crossing the Hudson River on the ferry that runs from the foot of Dyckman Street, New York, have been treated to the odd spectacle of a canoe sailing in their wake, all the way across, without any apparent means of propulsion. Only occasionally do the occupants of the canoe dip a paddle into the water to steady the craft and keep it on its course. What makes the canoe go, is a question that has puzzled many a one.



Stealing a ride on the waves of a side-wheel ferry boat

Almost everyone knows that immediately behind a side-wheel ferry boat there is a suction or an inflow of water to fill up the gap left by the vessel. No doubt, most of the ferry passengers have attributed the progress of the canoe to this cause, but the more observant must have noticed that the canoe does not keep to the comparatively smooth water directly aft, but rides off to one side in the rough waves that are kicked up by the paddle wheels; also that the canoe does not hug the ferry boat closely, but may pursue its mysterious course at a considerable distance, while travelling just as fast as the ferry does. Sometimes the canoeist rides an eighth of a mile behind the ferry boat. There is no hidden power plant in the canoe, and yet the bow wave that it makes as it speeds along shows that it is not carried along on a current of water. Another point to be noted is that the canoe alway stakes a position on the forward side of a wave, and that it holds this position all the way across. This lets out the secret for it is the wave that carries the canoe along, in the same way that the Hawaiian on his surf board rides at high speed for half a mile or more on the waves that roll shoreward. This does not mean that a current of water carries him forward, but that the waves do. The tide may be setting out and yet if the waves roll shoreward the surf board will go in on them despite the outgoing tidal current, because it is the waves that push it along.

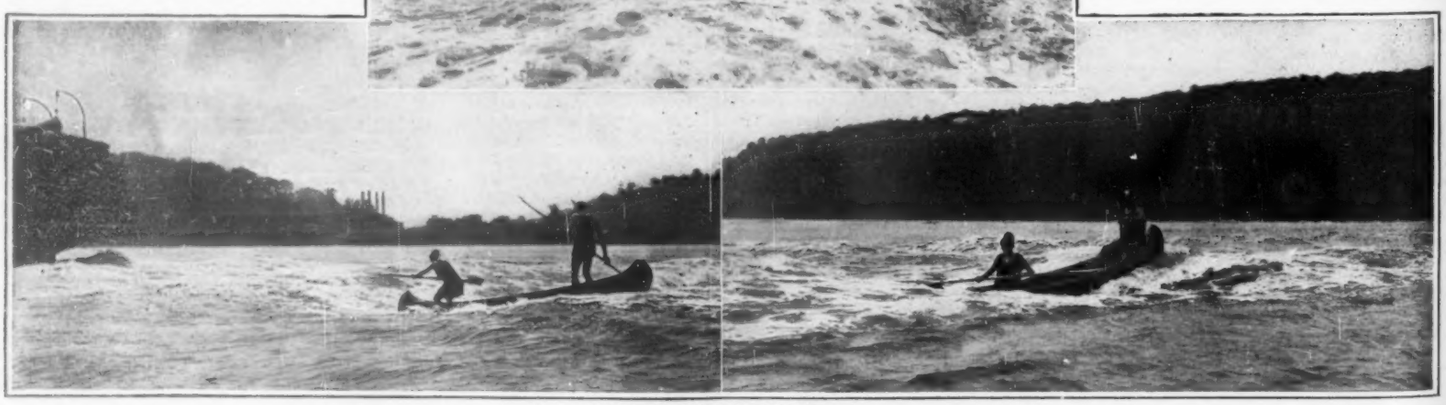
To illustrate the phenomenon, imagine a marble on a carpet. If the carpet is wrinkled by pushing it forward with the toe the marble will roll along ahead of the traveling wrinkle in just the same way that the surf board glides along pushed by the advancing waves. Of course the surf board does not roll, but it is pushed ahead just the same. Perhaps a more apt comparison is presented in the accompanying sketch of a bottle and a ruler. Lay a bottle on a table top and support one end of a ruler on it. Now if the bottle is rolled forward the ruler will slide ahead, just as the marble did ahead of the wrinkle in the carpet. The same is true of the canoe, which is shown in the same cut. The canoe stands in an inclined position on the side of the wave. As the wave advances to the position shown in dotted lines, the canoe must advance also. It cannot ride over the wave without running up hill and consequently it must be pushed along by the wave.

The man who has been performing this interesting experiment is Mr. C. H. Clark. Occasionally he makes the trip alone but our photographs show him accompanied by Miss Frances Ketchman. Mr. Clark informs us that one of the ferry boats he follows, makes a speed of about 12 miles per hour when under full headway.

Directly back of the ferry boat there is a suction producing a current of about two miles per hour in the direction in which the boat is traveling. The void back of the ferry boat is largely filled up by water flowing in from below. Back of each paddle-wheel there is a current in the opposite direction, of about three miles per hour. The waves are produced by the water lifted up by the paddles above the normal level. The water then drops and continues to oscillate up and down. Right at the paddles there is also a quantity of water that is being lifted up. In other words there is always a wave crest at the paddle wheels so that the waves which are formed always travel in the same direction as the ferry boat travels and at precisely the same speed, as long as the paddle wheels are running.

Although there is this forward motion of the waves at 12 miles per hour, there is a rearward current of three miles per hour, so that the canoe which travels on the waves must actually go through the water at 15 miles per hour, as long as it keeps up with the boat. It seems odd that the canoe can overcome this rearward flow, but the action will be clearly understood if we refer again to the marble on the carpet.

Suppose that the wrinkle is produced by a ruler that is moved along under the carpet and that while the ruler is moving forward the carpet is being drawn rearward. The marble will still continue to slide forward ahead of the wrinkle. This is exactly what the canoe does. There is not enough rearward current to carry it uphill over the crest of the waves and as long as the craft lies on the forward side of the wave it must progress with the wave and at the same speed as the wave. As a matter of fact the rearward current helps to maintain the canoe on the side of the wave and to prevent it from burying its nose in the trough of the waves. All that Mr. Clark has to do is to paddle his canoe to the proper position on the wave that he selects and then he may fold his arms and let the ferry waves carry him across. It is a surprising fact that he usually beats the ferry across, because when the ferry slows up the paddle wheels act as brakes and the waves which they have set up travel ahead of the boat carrying the canoe along with them. Although the occupants of the canoe like to indulge in feats of daring such as standing up in the light craft, as shown in our illustrations and performing various stunts, yet riding ferry boat waves calls for a considerable degree of skill and should not be attempted by any one but a strong swimmer. One of the pictures shows some of the dangers that are encountered. In a much traveled waterway such as the Hudson River there are apt to be cross currents which disturb



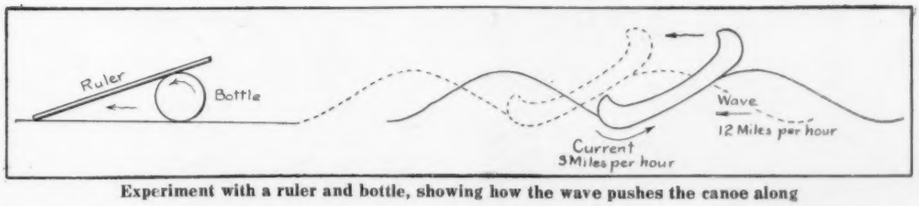
All photographs on this page by Edwin Levick

The picture at the left shows the canoeists riding well to the rear of the ferryboat. At the right they are shown comfortably seated on the side of a wave. In the picture above note the side slap at the bow, one of the dangers of this sport.

Snapshots of the canoeists riding the waves thrown up by the paddle-wheels of a ferry boat

the smoothness of the waves. There may be a side slap on the bow of the canoe that will throw it off its course, turn it around in the trough of the waves and upset it. The canoeist must be constantly on his guard to avert any such dangers.

Mr. Clark makes the interesting suggestion that in towing a small boat behind a vessel that is throwing up a considerable wave it is advisable to draw the boat to such position that it lies on the forward face of the wave instead of in the rear face of the wave, so that the wave will push the boat along and there will be scarcely any strain on the towing line.



Experiment with a ruler and bottle, showing how the wave pushes the canoe along

Multiplying the Average Motion-Picture Screen by Six

WHAT is, perhaps, the world's largest picture screen, higher than an eight-story building, is 115 by 115 feet. It was a feature of the recent Methodist Centenary Celebration in Columbus, Ohio.

Each night stereopticon views or motion pictures were thrown upon this gigantic screen 75 feet high and 100 feet wide, more than six times the size of the average motion picture.

The audience each night numbered thousands, sometimes as many as 30,000—the biggest motion-picture audience ever brought together at one time.

The screen cost $8,000 to build. It contains 100,000 square feet of lumber. It was built originally for giant stereopticon slides to illustrate the conditions and needs of the foreign and home land missionary fields, but the success in putting these before the crowds that flocked to the grandstand each night led the officials to believe that motion pictures ought to be tried.

Projecting machine experts were consulted. After experimenting several days and nights, they succeeded in throwing a picture 54 feet by 40 feet. Leo S. Dyer of Cincinnati, Ohio, continued the experiments until the size increased to 100 by 75 feet.

The ordinary motion-picture projector used was equipped with heavy-duty lamp houses, 2¾-inch equivalent focus lenses, 170 ampere rheostats and a special shutter—the extra light shutter, which relieves the eye strain of the onlooker and at the same time increases the light on the screen.

The films, which must be black-and-white without artistic effects, are run through the machine rapidly in order to prevent the powerful lamps from burning them. The pictures, however, are clear and distinct, and people 400 feet away can readily see them.

Disposal of Emergency Fleet Corporation's Surplus and Salvage Property

THE United States Shipping Board Emergency Fleet Corporation has arranged for the sale of its surplus and salvage property, including supplies, material, and equipment, at such times and in such manner as may be deemed to be to the best interests of the corporation and the nation.

Complete manufacturing plants, entire shipyards, drydocks, ships complete or half built, and any article down to scrap metal are among the items to be disposed of by public sale. These sales will afford an unusual opportunity to the industries which stand in need of material, equipment, and supplies of the kind employed by the Emergency Fleet Corporation in its numerous branches of activity, but there will be no "unloading" upon either the general or local markets.

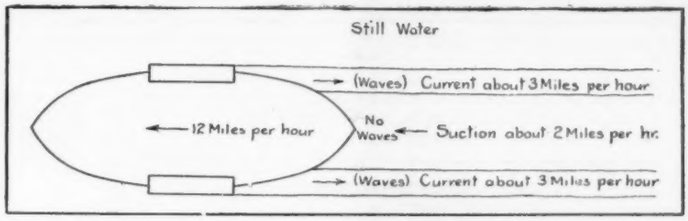
To sell to the market, and not to break the market, is the Government policy in disposal sales to be held by all its departments and branches. This policy will be strictly adhered to by the Fleet Corporation in offering its unused (surplus) and used (salvage) property.

Materials to be sold comprise an accumulation as a result of extensive war activities and are to be disposed of now only because of the adoption of the restricted shipbuilding program. Industries which may be especially interested in the sales are chiefly the shipbuilding, steel, railroad, structural, and general manufacturing concerns.

Upon the sales list are marine railways, housing and transportation projects, numerous allotments of machinery, equipment, and supplies, including woodworking machinery, machine tools, and fixtures, electrical machinery, boiler and forge shop equipment, marine equipment and accessories, air-compressor equipment, contractors' equipment and supplies, bridge and gantry cranes, steel plates, shapes, and bars, pumping machinery, scrap metals, lumber, deck equipment, galley equipment, hospital and commissary supplies, and the like.

All sales will be consummated either by open bidding on advertised items or from price lists made up after careful study of existing market conditions and approved by the Sales Review Board. To prevent speculation, every effort will be made to confine sales to those who, it is believed, have actual use for the property offered. But where the sales manifestly will cause no disturbance of general market conditions, they may be made, even though it be known that the items are being obtained for resale.

The corporation will coöperate closely with the other Government departments and the Chamber of Commerce of the United States in ascertaining market conditions, and wherever it appears that the unloading of a large quantity of any particular product will unduly disturb the regular trade channels or react unfairly upon particular industries, steps will be taken to limit sales and to distribute them over such periods as will most satisfactorily permit of absorption of the surplus stocks and material on hand without embarrassment to any interest concerned.


Still Water
(Waves) Current about 3 Miles per hour
12 Miles per hour
No Waves
Suction about 2 Miles per hr.
(Waves) Current about 3 Miles per hour

Currents in the wake of a ferryboat

Gold

THE world situation of gold has been the subject of much discussion and speculation. The war has caused the accumulation of gold in state banks and treasuries, and taken it away from private banks and the public. The holdings of state banks and treasuries have increased since 1913 from about 63 per cent of total stock to about 85 per cent. This has been compensated for by the issuing of paper money, and in some countries the paper issue has been so far in excess of the gold supply that a serious problem has resulted.

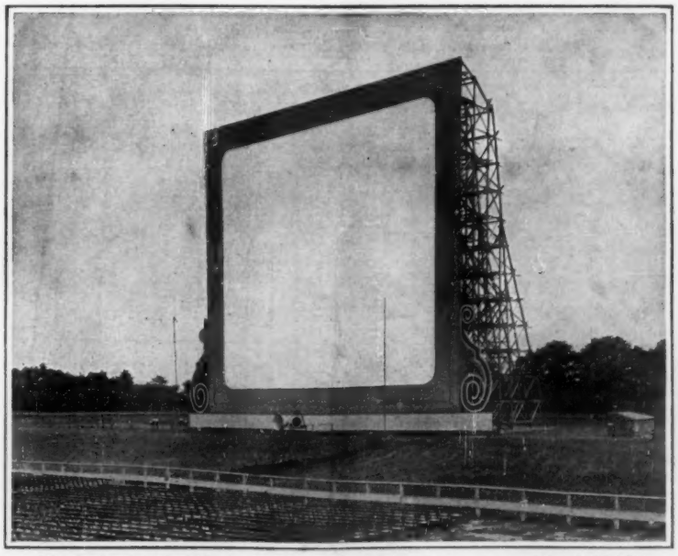
In 1914 the United States is reported to have had $1,871,611,723 in gold and $753,563,709 in silver, and in 1919, $3,092,037,699 in gold and $552,658,692 in silver, an increase of 65 per cent.

The production of gold has been steadily decreasing since 1915, when the highest point was reached. In that year the world's production of gold was $468,724,918, of which the United States produced $101,035,700, South Africa about $188,000,000, and Australia about $50,000,000. In 1918 the world production was $377,300,000, of which the United States contributed $68,493,500, South Africa, $716,000,000, and Australia, $26,700,000.

Recently the restriction on gold has been removed by the United States and a decided movement has taken place. England has not yet raised the embargo on gold because of the fear of depleting her gold supply which it is necessary to maintain at all costs. Remedial measures suggested have included raising the bank rate to check exports, and increasing imports of gold. These measures, it is claimed, would check the production of nonessential commodities and the tendency toward speculation which a low money rate encourages.

Australia has placed the exportation of gold in the hands of a Gold Producers Association, and they are permitted to sell their gold for three months and thereby may procure a premium over the standard price. This move was apparently a relief measure calculated to offset the increased price of producing gold.

There is nothing suggestive of a gold embargo in Germany. On the contrary that country has begun to send gold to the United States to pay for foodstuffs and raw material, which latter she is sadly in need of. Germany has cleverly maneuvered her gold resources which France expected would become part of the indemnity.



Measuring 115 by 115 feet, this motion-picture screen entertained 30,000 persons at one time

The Current Supplement

ONE of the most fascinating of all studies has always been that of animal instinctive traits versus "acquired" characters. We are accustomed to cite the bee as among the most intelligent as well as the most gifted of animals, our fancy being caught and held by, among other things, the beautifully regular forms shown by the larger number of the cells of the honeycomb. Long years ago careful, thoughtful students reached the correct understanding of the reason for the hexagonal form of those cells; but their reasoning has often been lost sight of, and all students welcome the excellently illustrated demonstration of the true explanation set forth in the article *How Honeybees Produce Honeycomb*, published in the current SCIENTIFIC AMERICAN SUPPLEMENT for August 16th, 1919, being No. 2276.

An interesting paper with illustrations sets forth the superior qualities of *Monel Metal*, a recently devised alloy whose strength, hardness, and resistance to tarnish make it specially welcome in many lines. In a much longer article some of the peculiar relations between *Evolution and Sexuality* are discussed at some length. A reprinted article of interest to those who have to deal with railway designing, discusses under *Wind Resistance and Railway Speed* the important subject of engine design and general train design looking toward decreased air resistance by practical improvements in design. The valuable curves of performance of the NC-3 airplanes and a discussion of their development is given in the second instalment of the article on *Progress in Naval Air Construction*. a related article discusses the general features of *Multiple Engined Airplanes*. Shorter articles discuss a report on *Use of Pulverized Coal* in England and the United States; the generally unconsidered possibility suggested by *Rainfall and Horsepower*; and the causes for brown patches in lawns, etc., under *Rhizoctomia in Lawns and Pastures*.

Our Technical Achievements in the Great War—III

Transporting 2,000,000 Soldiers and 71,452,000 Tons of Supplies to France

DURING the 19 months we were in the war, over 2,000,000 soldiers were carried to France, and of these 500,000 went over in the first 13 months and 1,500,000 in the last six months. As we stated in our series of articles on the work of the Army Ordnance Department, the Allies, upon our entrance into the war, assured us that our greatest contribution to the common cause would be the shipment of men, and that they (the French and British) could equip with artillery, field and heavy, a million men in six months' time.

Within a few weeks after our entrance into the war, we began to ship men to France—slowly at first, for we had only a few American and British troopships chartered directly from their owners. During the early winter of 1917, as the former German liners were repaired and put in service, embarkations increased to 50,000 per month; but by the end of the year they had increased to 194,000 per month.

Early in 1918 the British assigned three of its largest transatlantic liners and four of its smaller troopships to the work, with the result that there was an increase in troops transported to 84,899 for that month. It was in March that the great German drive in Picardy began and at once every ship that could be secured was pressed into service. The British furnished a great fleet of ships, and the combined effort was responsible for what Colonel Ayres justly calls "a transport miracle." Before July 1st, 1,000,000 men had been embarked, and in July the amazing total of 1,306,350 men was reached. Before the end of October the second million men had sailed.

So that our soldiers, at the height of the movement, were carried to the theater of war at the rate of over 10,000 men per day.

The record was exceeded in the return movement when, during the month of May 333,333 men, soldiers, sailors and marines were brought back to the United States.

The Great Transport Fleet

The call for a great transport fleet came when the world shortage of tonnage was most acute, and its growth was progressive and truly phenomenal. On July 1st, 1917 it totalled 94,000 deadweight tons; December 1st it was 562,000 deadweight tons; June 1st, 1918, 1,579,000 deadweight tons; September 1st, 2,034,000 deadweight tons and on December 1st, 3,246,000 deadweight tons, of which 390,000 tons was for troop and 2,753,000 tons for cargo service.

Composition of the Transport Fleet

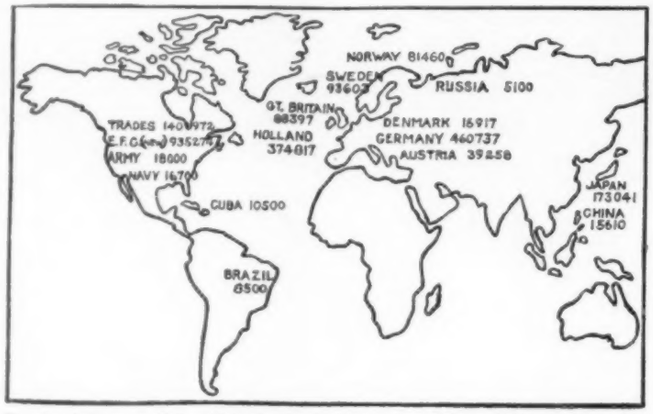
Every possible service was called on to supply ships for the transport emergency. The first great increment was the seized German ships. Another great interest was due to the taking over of Dutch ships and the chartering of Scandinavian and Japanese shipping. The emergency Fleet Corporation turned over nearly a million tons of new ships, and the Shipping Control Committee transferred nearly a million and a half tons from our export and import trades for Army use. Army vessels were secured from 12 nations as shown in the accompanying chart in the form of a divided circle.

Troops sailed from 10 American ports including four in Canada; as is shown in the map on facing page, the ports of arrival in Europe were even more numerous than the ports of embarkation in America.

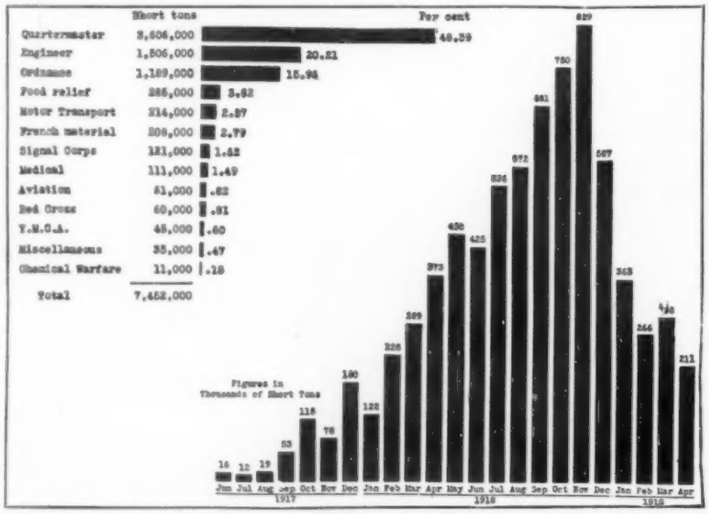
Meanwhile (and of this little was said during the war), a cross-channel fleet was built up for carrying men and supplies from England to France. This grew steadily to a maximum of 338,000 deadweight tons by January 1st, 1919.

Allied Help in the Transport Service

"Credit for the troop movement," says Col. Ayres, "must be shared with the Allies, and with the British in particular, since approximately half of the troops were carried in their ships. Among every 100 men who went over, 49 went on British ships, 45 in American ships, three in those of Italy, two in French, and one in Russian shipping under English control."



Deadweight tons of American Army shipping secured from different countries


Short tons
Per cent
Quartermaster 3,606,000 48.39
Engineer 1,506,000 20.21
Ordnance 1,189,000 15.96
Food relief 286,000 3.82
Motor Transport 214,000 2.87
French material 208,000 2.79
Signal Corps 121,000 1.62
Medical 111,000 1.49
Aviation 61,000 .82
Red Cross 60,000 .81
Y.M.C.A. 45,000 .60
Miscellaneous 35,000 .47
Chemical Warfare 11,000 .18
Total 7,452,000
Figures in Thousands of Short Tons
16 12 19 53 118 76 130 122 226 269 373 450 425 536 672 861 780 829 567 263 244 190 211
Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
1917 1918 1919

Vertical columns show tons of army cargo shipped each month. Horizontal lines show tons of cargo shipped to each Army Supply Service up till April 30, 1919

The large number carried in American ships was largely due to the fact that, in the emergency, ways were found to increase the loading of our own transports by as much as 50 per cent. Moreover, our transports exceeded those of the Allies in the speed of their "turnarounds." During the spring, summer and autumn of 1918, the performance of both cargo and troop ships became standardized at about 70 days for cargo ships and 35 days for troop ships. The "Leviathan" and "Mount Vernon" averaged about 27 days, and during the summer the "Leviathan" averaged about 12,000 men, the equivalent of a German division, landed each month in France.

How 7,452,000 Tons of Cargo Was Carried Over

The first shipment of cargo for the forces abroad was moved in June, 1917, and amounted to 16,000 tons. After the first two months the shipments grew rapidly, until in the last month of the war they reached 829,000 tons. The shipment of cargo was done almost entirely in American ships, less than 5 per cent being carried in other bottoms. After the armistice the ships were put back as speedily as possible into the trade routes or the carrying of food for relief work in Europe. By April the total cargo fleet was only one-third as large as it had been five months before.

The cargo carried consisted of thousands of different articles of the most varied sorts. The Quartermaster Department called for the largest share, or 48.39 per cent, consisting chiefly of food and clothing. Engineering and ordnance called respectively for 20.21 and 15.96 per cent. The other elements brought the total up to 7,452,000 tons.

The following interesting details may be noted: Consolidated locomotives of the 100-ton type to the number of 1,791. Of these 650 were shipped, complete on their own wheels, so that they could be unloaded on the French tracks and in a few hours be run out of the yards under their own steam. Special ships, with hatches large enough to pass an entire locomotive, were used, and when the Armistice was signed the Army was prepared to ship these set-up locomotives at the rate of 200 a month.

The Army also shipped 26,994 standard-gage freight cars, 47,018 motor trucks, which in November were going over at the rate of 10,000 per month; while rails and fittings for French railways and for our own lines of communication aggregated 423,000 tons. Also 68,694 horses and mules were sent over, and the rate rose to 20,000 a month. General Pershing also brought into France by his cross-channel fleet large amounts of cargo, including 275,000 tons of coal.

Small Losses at Sea Due to U. S. Navy

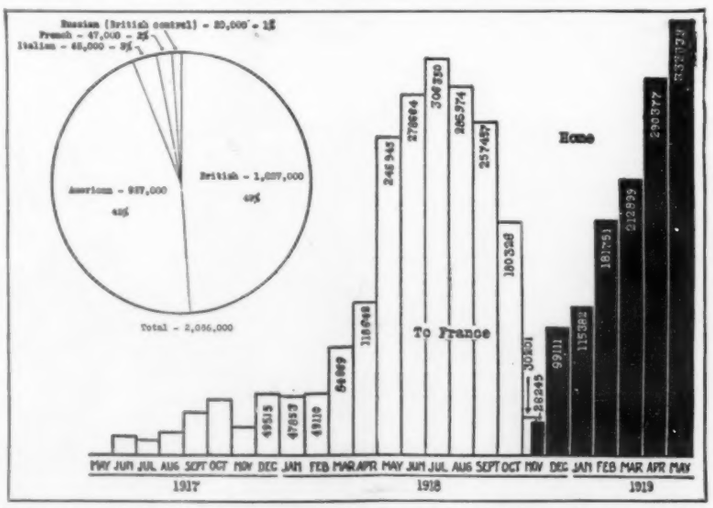
Our losses at sea were only 200,000 deadweight tons. No American troop transport was lost on its eastward passage. "For this splendid record the Navy, which armed, manned, and convoyed the troop transports, deserves the highest commendation."

How the Troops Were Brought Home

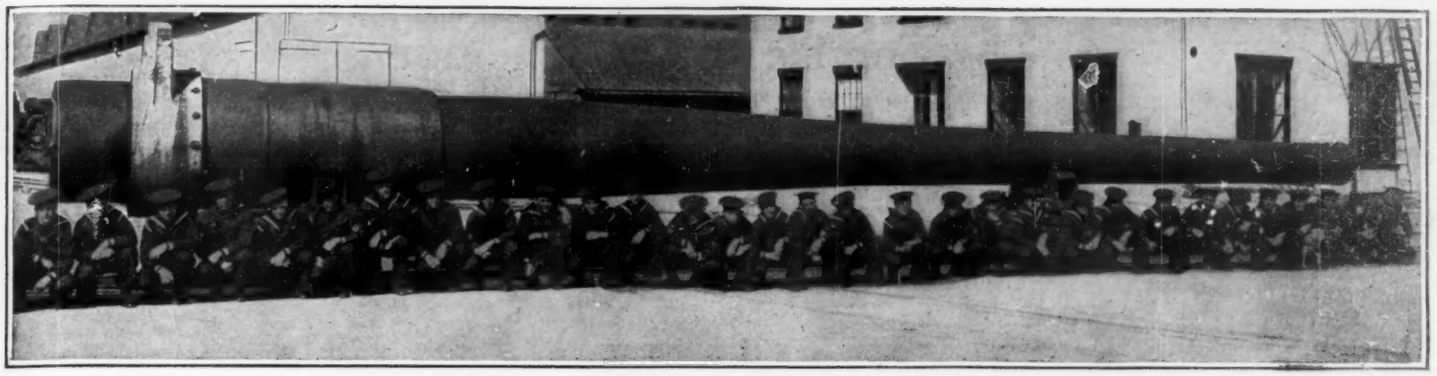
By a study of the diagram showing the troop movement it will be seen that the figures mount even more rapidly and reach higher totals than those of the eastbound journey.

The rapid return of the troops was rendered difficult by the fact that the British needed their ships for the return of their troops to Canada, Australia, New Zealand and South Africa. The situation was met by the Army Transport Service, which immediately began the conversion of our large cargo ships into troop ships.

By means of these converted cargo ships, by the assignment of the large German liners, and also by the great assistance of the Navy, which put at the Army's disposal a large number of battleships and cruisers, the Army was brought back even more rapidly than it had been taken to France.


Russian (British control) = 80,000 = 1%
French = 47,000 = 2%
Italian = 45,000 = 2%
American = 927,000 = 45%
British = 1,037,000 = 50%
Total = 2,056,000
To France
Home
MAY JUN JUL AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY
1917 1918 1919

White columns show men sailing each month to France; black show number brought back to United States. Circle shows proportion of our troops carried by Allied ships



A fourteen-inch naval gun which, without accessories of any sort, weighs 198,000 pounds

Re-gunning a Battleship's Turrets

HOW long do guns last? Visitors to battleships of the United States Navy often ask that question, after seeing huge naval guns at close range for the first time. The answer surprises them, for they invariably think that guns last indefinitely, and once installed in a turret remain there until the ship becomes old and obsolete and is eventually placed out of commission.

Modern cannon are comparatively short-lived. The cannon of past decades were smoothbores which fired round shot and, although the scouring effect of powder gases might enlarge the bore to almost any extent, the question of accuracy was of no great importance. Gunners did not ignite the fuse until they "saw the whites of the enemy's eyes." In order to accomplish this the daring captain always endeavored to get into close range and even lash his ship alongside the enemy, depending upon the ability of his gunners to fire more shots than the latter, thus winning a quick, decisive victory. Besides, it was practically impossible for the old-style cannon balls to penetrate the thick wooden hulls of the men-of-war of the age except at close range.

High-powered naval rifles are built of sections superimposed upon a rifled tube or liner. At first the liners were cylindrical, but to facilitate removal they are now made conical in shape on the outside. The outer sections, usually known as hoops are shrunk on to the liner by the application of heat, the outer diameter of the liner being slightly in excess of the inner diameter of the hoop shrunk upon it. This construction is known as the principle of "initial tension"—*i. e.*, the increased resistance of a tube constructed of several concentric cylinders assembled over a single tube causes a stress between them. This stress is one of compression on the inner cylinders and extension on the outer, and necessarily varies in intensity. The resultant stresses increase the resisting power of the gun to internal pressure.

After the tube and hoops are assembled the gun is rifled. This consists of cutting spiral grooves in the bore, which is done in order to impart a rotary motion to the projectile, thus preventing it from tumbling during its flight from the gun to the target. As both gun and projectile are made of steel, it is necessary to fit a comparatively soft though tough copper rifling band near the base of the shell. The rifling cuts into the band as the shell advances through the bore, thus imparting a spinning or gyroscopic motion. As it speeds on its way, the longitudinal axis of the shell is always tangent to the trajectory or curve of flight.

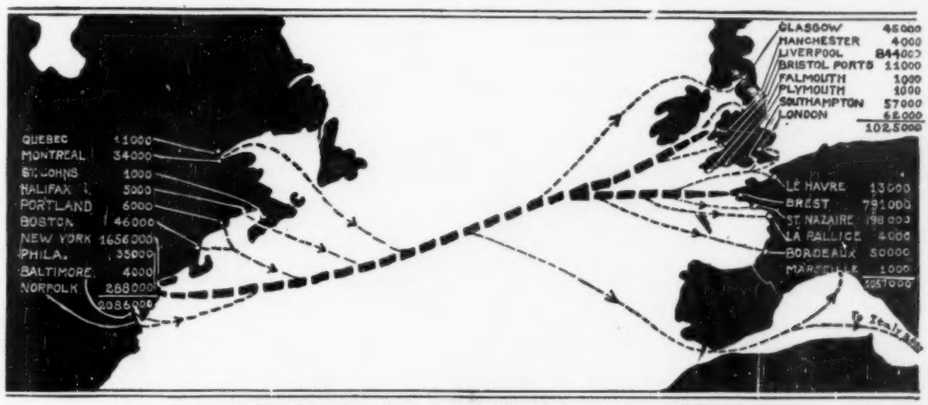
The intense heat caused by the expansion of gases produced by the burning powder is imparted to the walls of the gun, and the speed of expansion of the gases as they propel the projectile through the bore, scours the interior surface of the metal and quickly wears out the rifling. This is known as "erosion." When erosion progresses to the extent that accuracy of flight is impaired, the gun must be relined. Thus it may be inferred that the life of a gun is measured by its accuracy. The actual number of shots which can be fired from naval guns of varying calibers before accuracy is seriously impaired, has been determined by experience, and in the United States Navy is over 250 rounds.

In order to maintain the Navy at the highest point of efficiency in gunnery, target practice is frequently held under conditions closely simulating actual battle. As a result, the guns wear out and must be replaced. It is a fixed policy of the Navy extending over years, that all guns mounted on board ship must at all times be capable of firing their full battle allowance of ammunition without loss of accuracy. The battle allowance depends upon the limited space for stowage in the magazines; and when it is understood that the weight of a 14-inch shell is 1,400 pounds and a full charge of powder with its container weighs 323 pounds, a total of 1,723 pounds, occupying 12.5 cubic feet, the great amount of space required for the stowage of ammunition for the twelve 14-inch guns of our modern superdreadnoughts can be realized.

The Navy maintains a reserve of guns on shore amounting to 25 per cent of the number afloat. These reserve guns are kept in excellent condition, ready at a moment's notice to replace those which have become worn out. The operation of replacing turret guns is one of the many things the Navy has to do in order to be ready at all times to perform its allotted task. The work must be speedily done, for a battleship laid up at a Navy Yard is a dead loss to the fleet.

When it becomes necessary to replace the guns of a battleship, the latter proceeds to a navy yard where new guns shipped from the reserve stock at the Naval Gun Factory awaits her. Workmen swarm on board and in a short time remove the turret top and front plates. The delicate gunsights whose working parts are machined to a ten-thousandth part of an inch are carefully removed and as carefully stowed away. The slightest burr or scratch might easily cause the gun to be fired with such great inaccuracy as to be entirely useless. Gun elevating gears and recoil cylinders are disconnected, electric firing circuits are removed and the turret has the appearance of being hopelessly dismantled. When all gear is cleared away, a huge floating crane comes alongside and lifts the gun and sleeve out of the turret, transferring it to block-

(Continued on page 168)



Troops sailing from American ports and landing in France and England

Gun turret of an American battleship with top removed to show interior

Gun turret with front plate removed

Removing the old gun from a turret by means of a powerful crane

Some phases of the re-gunning of battleship turrets as told by the camera

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

The Fifth Decimal Place

IT is not always easy for even some scientific men to appreciate the importance of extreme accuracy, and the tedious painstaking research to establish the correct value of an atomic weight, for instance, in the third, fourth or fifth decimal place has seemed to them to be a pure waste of high-class effort. We are apt to forget that any work which adds to truth and increases the total of our knowledge is not only well worth while but essential if material progress is to be made. In solving so called practical problems we draw upon our store of knowledge gained by means of pure scientific research almost always undertaken without immediate prospect of commercial application. We learn to use the smallest incidents and to evaluate properly differences that may be in the fifth decimal place.

To have the manufacturer accept this plan as applied to his own interests and proceed with a thoroughgoing investigation into the small things of his production methods is not always easy, but where it has been done the results have nearly always been economically important. There is the case where a certain large bleachery carried on a chemical reaction which they believed required some thirty hours to produce the desired result in the vegetable fibers. Being a large establishment there was a considerable investment in vats, storage tanks, reaction chambers, goods in process and buildings for housing the equipment involved in allowing the goods to remain in action over a period of 30 hours. After a time it occurred to some one to find out just how that reaction went forward, what effect small changes of temperature might have and whether any control could be exercised that would accelerate it. The net result was that the reaction was found to take place in but a fraction of the 30 hours, and without material changes in the equipment a way was found whereby it could be made to do its work satisfactorily in 45 seconds! To handle the same amount of fibre, yarn and cloth but $\frac{1}{7}$ of the capital originally invested was thereafter needed for this step in the manufacture.

There are many instances in which failure accurately to measure small differences results in serious loss. Dr. N. A. Cobb of the Department of Agriculture has pointed out that the failure to judge correctly the length of cotton staple constitutes one of our great unrecognized economic wastes. A long series of really accurate measurements on staple previously judged by experts displayed errors which were rather large, yet no greater than must be expected, considering the personal factors entering into the customary methods of judging staple. By employing micro-projection and a modification of the instrument used in measuring map boundaries and the length of other irregular lines, Dr. Cobb has demonstrated a rapid, accurate method which involves no technique too intricate for easy mastering. To determine the length of cotton staple accurately is not only important from the viewpoint of the grower, whose crop is valued on this basis, but also from that of the manufacturer; for it is to the ultimate fiber that his product owes its characteristics. The more he can know of this very small unit and the changes it undergoes the better can he manipulate it to meet his wishes.

For years it has been customary to trust operations at higher temperatures to experienced men who are expert in judging heat by the color of the object under treatment. We have met men whose judgment came within five degrees of the actual temperature in a coal gas retort and wherever high heats are employed we find men noted for this sort of thing. But we cannot depend upon the successors of such men, even five degrees may be too great a variation, and in these days of accurate measuring and recording instruments a concern is not justified in either depending upon such experts who must often be in error or in paying them high salaries. Pyrometry has changed the old order and accuracy in temperature measurements and eliminated grave difficulties in many plants. In the making of optical glass, temperature control is most important and quite beyond the abilities of the trained eye. There are long periods during which 10 degrees variation is an important matter, and light conditions in a glass furnace easily contribute to errors of observation.

Pyrometry has perhaps been of the most importance in the metal industry, and at the Chicago Meeting of the American Institute of Mining and Metallurgical Engineers, a symposium embracing nearly ninety papers will be held on the subject. Many of these will deal with the importance of accuracy in temperature measurement in connection with war activities, and this group of papers in book form will be a valuable contribution. The recording pyrometer leaves a record for future reference and guidance.

High temperatures are often taken as an indication that impurities have been volatilized, and here again the expert's eye has been the reliance. Thus when burning phosphorus out of steel in the Bessemer converter the tell-tale change in color has long been the indication of the end point of the reaction, but the use of a good spectroscope is far preferable from every viewpoint. Any intelligent man will soon master its use for this observation and results are positive and accurate. The exact instant when the last of the phosphorus has disappeared can be noted.

The spectroscope is of greatest use in scientific investigations, permitting the minute traces of elements to be readily identified. It is related that some years ago certain men were discussing those things which were beyond chemical analysis and concluded that the composition of the stars was perhaps farthest removed from the possibilities. It was not long afterward, however, that the spectroscope was perfected for astronomical use, and through its use we have come to know the composition of distant stars with exactness.

The frequent necessity of working with traces of materials had led to the development of micro-pyrometry for the measurement of temperature changes and chemical microscopy for analysis. Chemical microscopy not only works with minute quantities but performs analyses without destroying the sample which is necessary when the work is done by ordinary wet methods. How we laughed in the days not so long ago before Prof. Chamot had developed this science to its present state of perfection, when an errand boy was sent in by his foreman bearing an abrasion stone with two small yellow streaks and demanding to know what carat the gold was. It seemed that some gold teeth had been installed and the new owner was not sure that he had been given his money's worth. He wanted an analysis and so had sampled the teeth by rubbing them on the stone. Chemical microscopy can handle such samples qualitatively and to a large degree quantitatively.

Instance the case where a curator desired to know the composition of a very ancient coin and yet could not consider sacrificing any portion necessary for the usual wet analysis. The chemical microscopist simply rubbed the coin over a ground glass slide which removed a sample large enough to yield a report in 20 minutes without defacing the coin in the slightest degree. The old way would have required a day's time. The key in this remarkable work is crystallography and the data it will supply. Definite compounds crystallize exactly the same way, time after time, so a detailed study is made of the form, faces, angles and color of crystals of known composition. Unknowns are also crystalized and the microscopical method checked against the older procedure. By working from standard slides materials that do not crystalize may be identified. Polarized light is called to assist and a whole new series of constants prepared on starches and many other substances. Adulteration of spices, identification of cordage and textile fibers and metallography are other phases.

The reagents required by a chemical microscopist are about sixty in number, but one gram of each is sufficient for 10 years of daily work. The investigations are largely in the field of inorganic qualitative analysis where the unknown may be caused to form crystalline compounds, but there are records of important work in organic chemistry as well as in quantitative work. The components of a sludge residue from coal tar which had undergone special treatment were identified after but a few hours' work, whereas the chemist unfamiliar with these micro methods had been completely baffled. A highly valuable contribution to the war came by way of the chemical microscopist who solved several complex problems in small arms ammunition, and another who was able to contribute to the work of duplicating certain enemy smokeless powders, although having but a few grams from which to work. And the production of smokeless powder is a fifth-decimal-place operation, for innumerable measurements have to be made with the filar micrometer attached to the microscope, to obtain the desired characteristics in the final product and to maintain uniformity. Most of these accurate measurements are upon the diameter of the holes in the powder cylinder or grain. Some grains have seven such perforations and their diameters must fall within exceedingly narrow limits. When it is recalled that some smokeless powders have about 100,000 grains to a pound we can better realize the degree of fine work involved. Then consider the millions of pounds of such powder produced and you get an idea of what such control means.

The metallographer has done some work in a novel method for approximate analysis of alloys, using crystals as the basis. A sample of the alloy is highly polished until it is practically free from scratches and then etched to bring out the crystal structure. A camera lucida is attached to the eye-piece of the microscope and the crystals quickly outlined on paper; for the camera lucida enables the observer to see the image projected on the paper where the pencil may be seen in the same field. Having drawn the crystals those of a kind are cut out and the several groups of cuttings weighed to get the percentage. This is, of course, not an exact analysis, but where certain limitations are set in a specification or it is a question of the absence or presence of a substance the method has some merit.

It is frequently when working in coöperation with other sciences that a science is of most value. Last winter a fall of yellow snow in Wisconsin aroused much interest. An analyst could have secured enough snow to have determined the elements present, but their combination into minerals would have been largely guesswork and no doubt the result would have been unconvincing. The chemical microscopist was able to identify 35 separate minerals in the snow by methods that left no doubt as to their composition. This list submitted to the geologist brought out the fact that the most likely place to find that particular combination was Texas. The next step was to consult the weather bureau records and it was shown that a sand storm in Texas, moving toward Wisconsin, had gathered up the minute crystals to deposit them as the pigment of the yellow snow when conditions of moisture and temperature called for it.

We in America have long been given to superlatives and large units. We talk in tons and miles and acres and thousands of gallons, and pay too little attention to the all-important ultimate particle upon which all else depends. We gain the power such knowledge conveys only by the sustained pursuit of research.

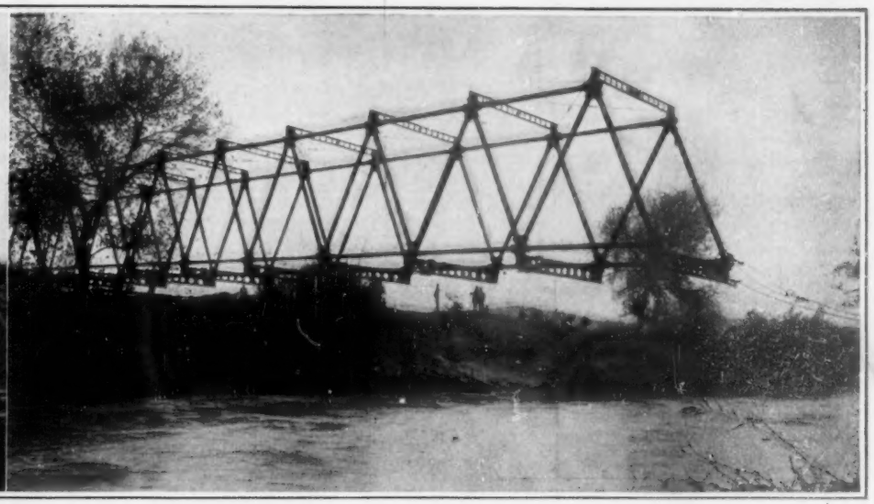
Tobacco Stems

THOSE who are adverse to the customary uses of tobacco may be unfamiliar with the considerable mid ribs and stalks of the plant. These parts are the principal source of the alkaloid nicotine which in a very dilute solution is deadly to many insect pests and to sheep-scab and mite, as well as ticks and lice.

Nicotine is a colorless liquid alkaloid with a specific gravity of 1.01 and has a boiling point of 246.7° C. It is highly soluble in water producing a strongly alkaline solution and the strength of the commercial product is usually 40 per cent. The methods of extracting the alkaloid from the plant are patented and the technique is largely a trade secret among the comparatively few firms producing either solutions of nicotine or its sulphate. Four methods or modifications of them seem to be employed, namely, absorption from smoke, steam distillation, water extraction and extraction with kerosene or other hydrocarbon oil. In most cases the process involves the removal of the alkaloid from the extract and in the case of hydrocarbon the solvent must be economically recovered.

Much work has been done on dust, stems, sweepings and the liquor into which leaves are dipped to soften them previous to removing the midribs, to determine the nicotine content and its variation with the ripeness of the plant. The average per cent found in stems by one analyst is 0.99, stalks 0.57 per cent, dust 1.67 per cent and scrap 1.87 per cent. The principal source of waste is stems and mid ribs, which constitute approximately 20 per cent of the raw tobacco as delivered to cigar and cigarette manufacturers. Some progress has been made toward using this material in a manner to yield a greater return than is derived from handling a large volume to secure a small quantity of nicotine. One plan contemplated treating the stems as a raw material for the formation of a sheet which could be used to wrap small cigars and similar products. This material was produced and while made entirely of tobacco the question at once

(*Continued on page 168*)



Photographs by the American Colony, Jerusalem

Military bridge about to be thrown across the river Jordan

The light tubular bridge being cantilevered across the river. The far end is weighted with rails

Bridging the Jordan in War Times

THE work of the engineer in war calls for the utmost exercise of ingenuity. He must be ready to surmount all manners of difficulties at a moment's notice, and he must do this without taking time for any elaborate consideration of the conditions to be encountered and with such materials as he may have at hand. One of his greatest problems is that of bridging streams, a task that often has to be performed in the face of hostile fire. As the streams vary in length and in character he must have standardized materials on hand which will fit any condition. In the SCIENTIFIC AMERICAN of May 5th, 1917, we described the ingenious bridging methods of the Germans in their Balkan campaign. Many mountain torrents were encountered in Serbia, and as the retiring Serbians destroyed bridges in their wake, the advancing Germans had to replace them in a minimum of time, in order to prevent the enemy from concentrating against them, and furthermore the bridges had to be built of a substantial character so as to permit transportation of heavy artillery. In that case it will be recalled that the bridges were composed largely of pressed steel plates of standard size which were bolted together like the mechanical construction toys that our children play with.

Another type of military bridge, which was employed by the British, is illustrated on this page. The bridge members consist of steel tubing with special steel fittings used to join them. The transverse members at the top and the bottom consist of light eye bars which are punched out in order to reduce their weight to a minimum. Our illustrations show a bridge of this type being put across the River Jordan in Palestine. The photographs were sent to us without any information as to the length of the bridge, but it is evident that it consists of 18 panels, and is probably about 180 feet in length. Being constructed of very light material the whole bridge was assembled on one shore of the river and then was cantilevered across the river.

The picture on the left shows the panel of the bridge in the foreground loaded with steel rails to act as a counterweight. The other picture shows the bridge almost entirely across the river with at least eight panels projecting clear from the bank. It will be noted that all the parts of this bridge are of the same size so that it could be made in any length required. At the top and bottom the panels are diagonally braced by means of rods tightened up with turn-buckles.

Romantic interest attaches to the bridge from the fact that this ancient river, of Bible fame, which was such a bulwark of defense in olden times must now succumb so tamely to the modern army engineer.

Nitro-Glycerine and the Oil Industry

WHEN a French chemist hit upon a new combination by mixing nitric acid, sweet glycerine and sulfuric acid in certain proportions, he didn't know it was loaded. The liquid was apparently safe and had the general appearance of lard-oil. This was in 1846 and while the liquid would burn in the crude lamps then used, with quietness producing a mellow light, it was over 20 years before it was applied to any useful purpose in the arts and industries.

In this period of 20 years, it had shown that upon concussion it would explode with terrible force and destructiveness. But owing to the limited production, the knowledge of its destructive powers was not common. Very small quantities of nitro-glycerine were made in certain laboratories in this country and sold by chemists that supplied homeopathic physicians, because it was discovered that a very small amount of this fluid, when rubbed on any portion of the body, would produce a severe and painful headache. It was also injected by physicians into the body of a patient requiring a strong heart stimulant and was used in many cases with excellent results. Readers of old newspapers will remember the publicity given nitro-glycerine when James G. Blaine was given doses of it upon his death-bed.

Further publicity was given when a small consignment exploded with great force upon a New York dock and caused the death of several men and the destruction of a warehouse. Investigation proved the liquid a product of a scant half dozen French and German chemists and it was not long before the formula was common property and the dangerous explosive was being manufactured in this country and was used, to some extent, by miners and quarrymen. The general use of it in the above industries did not become common on account of the fact that the explosive proved too strong and appeared to develop traits that characterized it as being freakish; and men, in many cases, refused to handle it on this account.

Meantime civilization marched on and in Pennsylvania crude oil or petroleum had been discovered in large and paying quantities by drilling a hole several hundred feet in the earth. The pioneers in this new industry immediately faced a serious problem and one that appeared impossible of solution. Paraffin formed hundreds of feet below the surface of the ground, and clogged and choked off the supply of oil and prevented it from flowing freely into the hole. A well would flow for a period, but with the forming of paraffin upon the oil-producing sands the production would gradually diminish to such a point that work on the property would prove unprofitable and the oil men faced a loss upon their investments. Various methods were tried, but all proved only a temporary remedy.

In 1860 Henry H. Dennis conceived the idea of exploding a charge of gun-powder in the hole as a method of destroying the paraffin and increasing the flow of oil. It proved practical in a measure. Difficulty was experienced in getting a sufficient amount of powder in the right place, in setting the charge off while under water and oil, and the force of the explosion was always up the hole, following the lines of least resistance. Despite these shortcomings powder was used until November of 1864.

It was in this year that Colonel E. A. L. Roberts of Titusville applied for and secured a "process of increasing the productiveness of oil wells by causing the explosion of gun-powder or its equivalent at or near the oil-bearing point, in connection with superincumbent fluid tamping."

(Continued on page 170)

Oil well spouting oil and water into the air

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Mobile Grocery Store

THE usual proceedure of the customer going to market in cities is now reversed by the market coming to the customer, and the motor truck is responsible for this innovation as for many others. A Dallas, Texas, grocery company believes that the H. C. of L. can be materially reduced by cutting down its overhead charges and that savings made that way can be passed on to the customer. The householder purchasing agent mounts the car when it reaches her door and makes her selection of eatables while the car moves on to the next customer. When the selection is complete, the traveling store may be half a block or so from her home so she pays the driver-clerk-cashier and walks back home. The residents of our rural districts were served from itinerant butcher and provision carts for some time back but the limitations of animal power had to be reckoned with and only short routes could be covered, not always at a satisfactory margin of profit.

The mobile grocery illustrated is said to be the first self-serve, operated-on-schedule, automobile grocery in the world, according to H. A. Weiman, the owner. He has applied for patents and expects to sell the idea throughout the country. The body is six feet wide, and fourteen feet long. It is mounted on a popular light truck chassis of moderate power and runs on pneumatic tired wheels. Reliability of motive power is essential in maintaining the schedule. The driver of this grocery wagon does not leave the wheel while his customers select their goods. A complete line of meats, groceries, green vegetables and everything else typical of the grocery store is carried and the money for goods selected is paid as the patrons leave the car. Thus is eliminated the terror of the high rent districts.

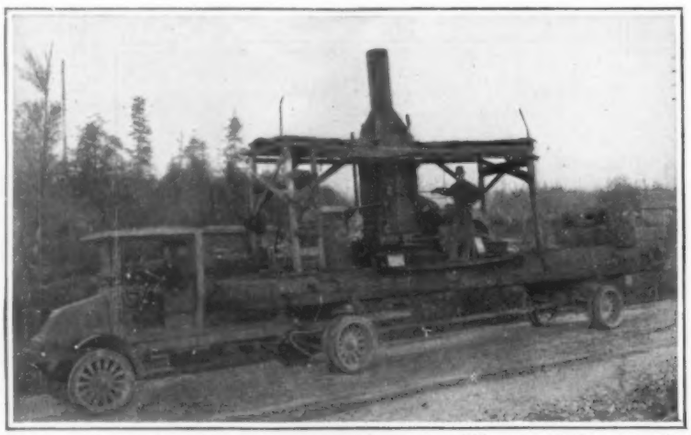
Bringing the grocery to the customer via motor truck

Trailers Reduce Transport Costs

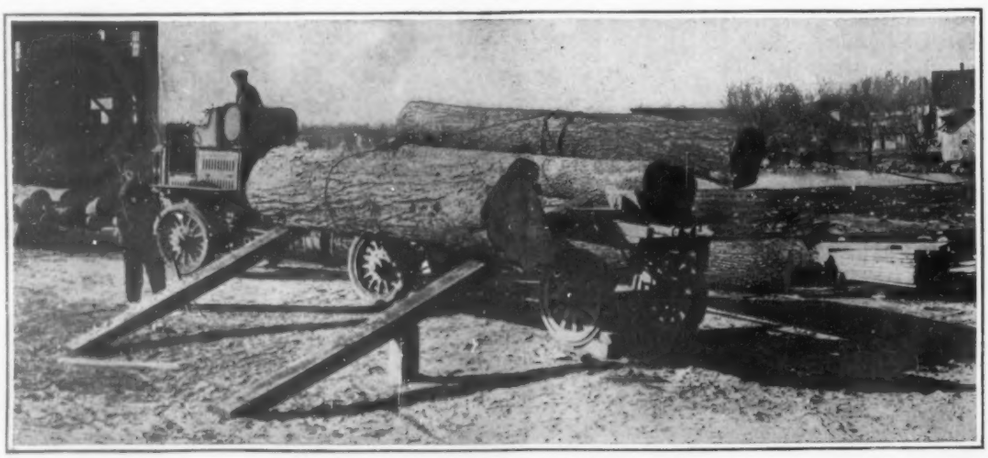
A LARGE box manufacturer in Chicago reports a splendid record made by two truck tractors and three trailers which have reduced his costs by half and made possible the delivery of 30 to 60 tons of boxes per day to a large mail order house in that city, a feat that he could not do with his previous horse drawn equipment, not to mention the delivery of many additional tons to other customers. As is possible with adequate trailer equipment, one trailer is loaded at one end of the route while another is being unloaded, and in this way the two tractors are kept continually at work. The tractors are of different capacities, one being a light duty tractor and the other heavy duty tractor, but in this particular work there is very little difference between the work done by each tractor, the trailers all being of the same capacity. The loads average six tons a trip, although they have gone considerably higher than that on occasion.

The trailers are 20 feet long, seven feet wide and eight feet high, and were originally designed to carry fabricated boxes. Owing to the limited storage space of the customer despite its 40 acres and hundreds of buildings, the boxes are delivered "knockdown", yet the same volume as of fabricated boxes, entailing a far greater weight, is carried by the tractors and trailers. They make five trips each work day over six-mile hauls, each tractor hauling about 30 tons a day. Figures supplied show that with teams, haulage of 60 tons a day costs $40, while at present, even with advanced costs of haulage, this is being done by tractor with a cost of from $17 to $20 a day.

There seems to be no limit to the hauling work that can be done by an intelligent application of the trailer and semi-trailer principle. The accompanying illustration shows an emergency moving job in which a standard 3½-ton truck was utilized as motive power and a complete donkey engine outfit mounted on its skids was moved with the aid of a pole or log trailer to support its rear end. The complete power plant illustrated presented a moving problem more on account of its bulk than its weight, considerable as that was.



A unique job for the trailer which gave necessary portability to a stationary engine



Handling big logs by motor-truck-engine power

Good Roads Fuel Saving Test

THE increased fuel consumption called for when trucks are operated over poor roads or under conditions where traction resistance is so high as to call for use of speed reduction gearing or large throttle openings was clearly shown in a recent test made by a prominent tire manufacturer in Ohio over good, medium and bad roads.

Five new army standard model trucks were operated over seven different types of road surface. A gain of six miles per gallon of fuel between the best and worst types of roads was obtained. All of the trucks were empty during the test. The trucks loaded showed that the poor roads took seven times as much gasoline per mile as the good one. The test results disclosed an average of 5.78 miles per gallon over a dirt road in good condition, 7.19 over fair gravel, 9.39 over good gravel, about the same over fair bituminous macadam and good brick roads, 11.44 over extra smooth brick and 11.78 over good concrete. The tests revealed that the saving to the motoring public in gasoline alone if good roads were universally found would amount to millions of dollars annually. Perhaps equal to this would be the saving in tire cost, which is considered a more important item of car upkeep, than is gasoline. Calculating the saving in wear and tear on the mechanism of cars and trucks and also the item of time lost by poor roads, adequate highways are undoubtedly a valuable and essential investment in conservation of our national prosperity.

Winch-Equipped Trucks for Lumbering

A METHOD of handling large logs by motor-truck-engine power is shown in the accompanying illustration and is a time and labor saver in lumbering operations. The truck is equipped with a winch such as developed for United States Ordnance four-wheel-drive trucks and shows an industrial application of a device designed primarily for war work. The winch is located at the rear end of the truck chassis and is driven by the truck power-plant through a power take-off from the transmission. In this case, the cable has been run over to a pulley and brought over the trailer. Tow skids are placed alongside the trailer being loaded, the winch on the truck is thrown into gear and the logs rolled up the incline onto the trailer bed. It is only a matter of a few minutes before the trailer is loaded and ready to be on its way.

Trucking Freight Over Gobi Desert

AN agricultural colonization company has just purchased thirty three-ton trucks of American manufacture, which will be used on a freighting proposition beside which

(*Continued on page 172*)

Copyright 1919, by The Goodyear Tire & Rubber Co.

"TO sum up the reasons why we use Goodyear Pneumatic Cord Truck Tires, I will say that, (1) the big pneumatics are a great deal easier on the truck, the driver and his helper; (2) they are easier on the goods being hauled; (3) chassis upkeep much lower; (4) greater gasoline mileages; (5) greater operating radius of truck; (6) the Goodyear All-Weather Tread makes driving safer; (7) therefore, an all-around economy in motor delivery."—Mr. Fred W. Albrecht, Proprietor, Acme Chain of Basket Stores, Akron, Ohio

THE statement above is based on a direct comparison of the work done by a solid-tired truck and one shod with Goodyear Pneumatic Cord Truck Tires.

A monthly cost analysis has shown a difference in upkeep of about 33⅓% in favor of the Goodyear Cords; and a similar difference in the gasoline account.

Other observations: the truck on Goodyear Cords frequently has accomplished twice as much hauling; the traction of the pneumatics has offset conditions that stall solid tires; fresh bread always has been distributed on the pneumatics because of their protective cushioning.

The record is rounded out by the fact that the powerful Goodyear Cords demonstrate their toughness in this exacting service by running up mileages of 23,000 and more.

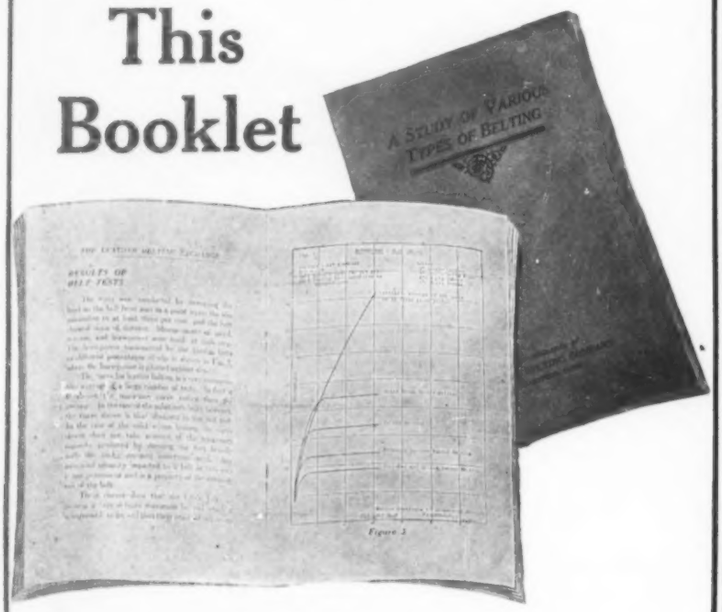
Certainly the entire experience explains the action of truck owners who change over to Goodyear Pneumatic Cord Truck Tires without waiting for solid tires to wear out.

THE GOODYEAR TIRE & RUBBER COMPANY, AKRON, OHIO

GOODYEAR

AKRON

Write for This Booklet



It Will Help You Solve Your Belting Problems

The Mellon Institute of Industrial Research, of the University of Pittsburgh, has gathered information of interest to every user of power, in the results of its

Scientific Tests of Belting Materials

The investigations of this institution are entirely unprejudiced and conducted solely with the view of obtaining accurate and scientific solutions of industrial problems.

The booklet containing the results of the Belting Tests will be of invaluable aid to you in finding the right belts for your different drives.

Clip the Coupon and Mail it Today

The Jewell Belting Company
HARTFORD CONNECTICUT
Chicago Branch: 2837 So. La Salle St. New York Office: 2 Rector St.

The Jewell Belting Company, Hartford, Connecticut. Dept. A.

Please send me a copy of the Mellon Institute's Booklet, "A Study of Various Types of Belting."

Name.....

Name of firm.....

Street.....

City.....

Our Proposed 1,000-foot Steamers

(Continued from page 151)

northwest gales it would be necessary to construct a breakwater from the easterly side of the bay. They add that this would be a difficult undertaking, as the seaward end of the breakwater would be in a 90-foot depth of water.

On the other hand, the great depth of the harbor is such as to permit the deepest draft vessels to enter and depart at any stage of the tide, a consideration of great importance with liners of the projected type and of the proposed service. It also avoids the great congestion and danger of navigation in such a crowded harbor as New York habitually is.

Among other expenses to be reckoned in the general cost would be the necessity of establishing an immgration station with accommodations for a force of inspectors and attendants adequate to care for the 1,200 steerage passengers which the new type of vessels could carry. Also a custom house and a quarantine station would have to be provided for.

All in all, it would seem that the Fort Pond Bay plan is not altogether practicable, not only because of the heavy expenses in preparing it as a terminal, but also because of the inconvenience to passengers. It cannot be denied that the passenger coming from Europe prefers to land in New York City proper, or at least as near to New York as is possible. It is then a simple matter to take a taxi or even the surface line car, subway, or elevated train to one's destination; whereas, landing at the eastern end of Long Island, the passenger would be confronted by a long ride of at least two hours to reach New York.

A Salvaging Submarine

(Continued from page 155)

running directly through the submarine from top to bottom, and a framework is erected on the deck, to facilitate the raising and lowering of a 10-inch suction pipe, which runs from the houseboat, along the outside of the tube to the submarine through which it passes from top to bottom. This suction pipe can be used to reclaim cargoes such as coal from sunken vessels, and Mr. Lake has already put some coal, recovered from Long Island Sound in this manner, on the market in Bridgeport, at a cost to him of 50 cents a ton. Inasmuch as over a million tons of coal is said to be sunk in Long Island Sound alone there seems to be some opportunity for use of the apparatus at once on this work.

For submarine construction, workmen using this diving compartment need have no special experience. Neither need they be so careful of their apparatus as divers find it necessary to be, and they are not cumbered by heavy awkward suits. With the submarine close to the bottom it is possible to get out and walk on the ocean bed with no more protection against the water than rubber boots, and in salvaging, the entire submarine might readily be lowered directly through a hatch on some of the large sunken freight ships.

After being beneath the surface a little over an hour Mr. Lake and I entered the air lock, closing the door behind us, and leaving the two men of the crew to close the trap door and come on deck later. A small valve was opened in the door leading to the tube and as the compressed air escaped the chamber filled with vapor so dense that I was unable to see the wall two feet away. The electric lights in the compartment imparted their rays to the vapor until it seemed itself to be luminous.

When the pressure had been reduced to that of the atmosphere above, the door to the tube was opened and we climbed up to the houseboat, without having felt for a moment any effects, except that slight pressure in the ears, that were in any way different from those normally experienced above the water. It is true, of course, that we had been lowered to no great depth, not having descended past the 20- or 25-foot mark, but even at that depth the dis-

(Continued on page 168)

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

SCIENTIFIC AMERICAN
contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

MUNN & CO., SOLICITORS OF PATENTS
626 Woolworth Bldg., NEW YORK and 625 F Street, WASHINGTON, D. C.
801 Tower Bldg., CHICAGO, ILL.

Annual Subscription Rates
Scientific American Publications

Scientific American (established 1845) one year $5.00
Scientific American Supplement (established 1876) one year 5.00
Postage prepaid in United States and possessions, Mexico, Cuba and Panama

Foreign Postage
Scientific American $1.50 per year additional.
Scientific American Supplement $1.00 per year additional.

Canadian Postage
Scientific American 75c per year additional.
Scientific American Supplement 50c per year additional.

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application

Remit by postal or express money order, bank draft or check

Classified Advertisements

Advertising in this column is $1.00 a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

PATENT FOR SALE

NEWLY patented Sanitary Tooth Pick Holder. A universal table necessity; simple, practical, serviceable and thoroughly sanit ry. Wonderful possibilities, non-competitive. Estimated sales of 25,000. Sell U. S. and Canadian patents outright or royalty. A 15c seller. Model and terms on request. Stephen G. Singleton, P. O. Box 911. Burke, Idaho.

FOR SALE

THE U. S. and Canadian rights to patent No. 1225472 combined search and tail light. The searchlight is operat d automatically when car is in reve se. Simple, durable and inexpensive to m nufacture. Copy sent on request. Harry Gilpatric, Springfield, Vermont.

WANTED

THE exclusive manufacturing rights of some machine, device, or article in the metal line—patented or otherwise, by one of the most completely equipped manufac uring plants in Indiana. Address: W. M. P.—P. O. Box No. 263, Bedford, Indiana.

BUSINESS OPPORTUNITIES

SUBSTANTIAL Manufacturing Corporation wants capable men to establish branch and manage salesmen. $300 to $1500 necessary. Will allow expenses to Baltimore as explained. Address, Treasurer, 416 N. Howard St., Baltimore Md.

INVENTIONS

HAVE you a practical invention to sell outright or place on royalty? Send details to Adam Fisher Mfg Co., 78, St. Louis, Mo.

SOMETHING NEW!

TAWKING Tyle letters and figures for Signs, Bulletins, House Numbers, Honor Rolls, General Publicity—Everybody a prospect—Big Profits. Quick Sales—Free Sample—Write quick. C. F. Lorenzen & Co., 204 Reaper Block, Chicago.

You can be quickly cured, if you
STAMMER
Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.
Benjamin N. Bogue, 807 Bogue Building, Indianapolis

$1 a Week pays for The Black Beauty

Send No Money
Ship'd on Approval Freight Prepaid

Don't buy an ordinary bicycle. Get the Black Beauty—most magnificent wheel in all cycledom. *Built on our own factory and shipped direct:* wholesale price. No middlemen's profits!

18 Exclusive Features

Get our Catalog: select your model. *20 Styles.* We ship at our own risk. Keep or return. No waiting to save up money. *Months* to pay—small amount on acceptance, then $1 a week. 5 year guarantee.

Sundries Get our factory prices first. Lowest in the country. TIRES, lamps, horns, etc. Everything for cyclists. Free Sundries catalog.

HAVERFORD CYCLE CO.
Dept. 158 Philadelphia

FREE Beautiful New Catalog in colors

Untiring

Says the Petry Express & Storage Co. of Trenton, N. J.

"We have been using four SERVICE Trucks in the hardest kind of work for several years and find them equal to any task."

Untiring day-in-and-day-out service — the ultimate test that every truck must meet — the user's test — is the record of performance that owners invariably speak of in their recommendations of SERVICE Trucks.

SERVICE MOTOR TRUCK CO.
WABASH, INDIANA, U. S. A.

NEW YORK
87-89 West End Ave.

CHICAGO
2617-25 So. Wabash Ave.

Service
MOTOR TRUCKS

Get that *extra* pound of pull —that *extra* ounce of breakdown prevention.

MAXIMUM production without delay is the order of the day in America's industries.

If you want to speed up production in your plant—look to your drives.

Genuine Baldwin Chain Drives from prime movers to machines from point to point on machines have shown hundreds of concerns in many lines of business the way to a greater uninterrupted output of more perfect products.

Genuine Baldwin Chain Drives give you all the advantages of belt and gear drives and more with none of the disadvantages.

Genuine Baldwin Chain Drives are flexible, positive, compact and durable. They operate equally as well on long and short centers.

The experience and knowledge of Baldwin's engineers are at your service without obligation. It will pay you to write for interesting data on Genuine Baldwin Chain Drives.

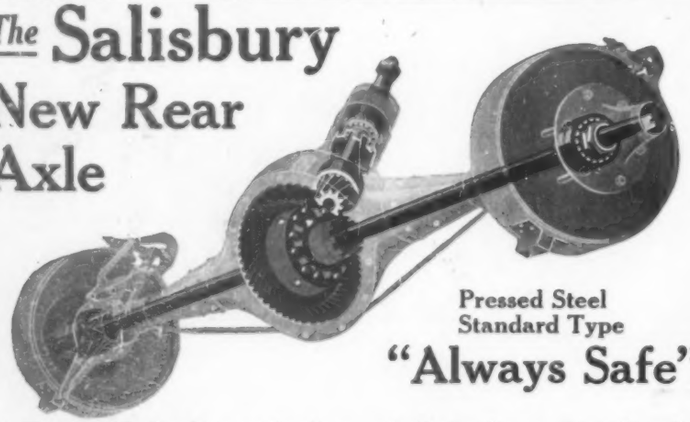
BALDWIN CHAIN & MFG. CO.
WORCESTER, MASS.

Western Office, Peoples Gas Building, Chicago

GENUINE BALDWIN CHAINS
AND SPROCKETS

BALDWIN—It's the chain that stands the strain

The **Salisbury New Rear Axle**



Pressed Steel Standard Type

"Always Safe"

AN automobile is only as good as its *rear axle*. Remember—you may have the best engine in the world in your car but that does not and cannot make it a *good motor car* unless the *rear axle* is mechanically correct and physically perfect.

Few people realize that the *rear axle* of an automobile is, next to the engine, the most important mechanical factor in producing a good automobile. The engine's power is transmitted to the *rear* (driving) wheels through the pinion gear of the propeller shaft and differential mechanism—all part of the *rear axle*.

The *rear axle* of a carriage or wagon carries the weight of the vehicle on the spindle. The *rear axle* of an automobile carries the weight of the vehicle on its *housing*—the pressed steel case which encloses the differential gear, driving shaft and all bearings—and includes the wheel hubs, brakes and brake mechanism complete ready for use.

One may better understand the importance of the *rear axle* when it is said there are over 150 individual parts of the *rear axle* mechanism that must be carefully machined and fitted to micrometer measure. This mechanism must be compact, silent and of great strength to transmit the power of the engine to the driving wheels with the least possible friction or loss of power.

The Salisbury New Pressed Steel Rear Axle is produced in our two big plants after 15 years' successful building of front and rear automobile axles, complete with hubs and brakes. It combines the great strength and durability of our own special formulae steel with simplicity of construction. Made in three standard sizes for cars weighing 1700 to 4000 pounds.

The automobile manufacturer who specifies our axles adds as a big selling point to the prospective purchaser.

SALISBURY AXLE COMPANY
Established 1902

Jamestown, New York, U. S. A.

PERU AXLE COMPANY
Established 1909

Peru, Indiana, U. S. A.

A Salvaging Submarine

(*Continued from page 166*)

comfort was not so marked as is that which a diver experiences when he is cumbered with heavy helmet and water-proof suit, with weights and tubes and telephone wires.

The practical applications of this new invention seem to be many. Great things were expected of the diving bell, when it was invented, but its supporters failed at first to consider the movement of the bell in the currents, the raising and lowering of it as the ship from which it hung tossed and rolled in the seaway, and the necessity of raising and lowering it to permit workmen to pass out and in.

This new apparatus has none of these handicaps. With a large spike attached to the bottom of the submarine it can be lowered into a definite position until the spike is embedded in the bottom, and despite any rolling and tossing that the houseboat may do, the submarine remains as immovable as the anchor to a ship, while workmen can pass to and fro from the surface to the depths with no difficulty except that of remaining in the airlock to accustom themselves to the changing pressures.

The invention is remarkable because of its simplicity. Whatever there is of a complicated nature about it is in the engine room of the houseboat, where are located the gasoline engines, the generators, and the storage batteries. Nothing more difficult than these to understand and to operate is to be found in the entire makeup of the vessel, while no structural difficulties of any moment are to be encountered in the design and construction of a vessel many times the size of this one that is already completed and in operation.

The Standardization of Standards

(*Continued from page 157*)

that such an organization is urgently needed. In the past there have been many occasions when two or more organizations have formulated standards for substantially the same thing. Often these differences have been very slight, but neither has been quite acceptable to the other party. In the majority of such cases, if these organizations had been brought together at the start they could have agreed on a standard that would have been satisfactory to both. The American Engineering Standards Association will furnish a means by which any organization intending to define a standard can readily ascertain what others are interested, and should be consulted in regard to it. At present there is no such means. There is nowhere anything approaching a complete list of the organizations doing standardization work, much less any list of the standards proposed or in preparation. The enormous advantage of having any standard generally accepted, and the much greater probability of accomplishing this if it is prepared under definite conditions that have proved effective in the past, will, it is believed, cause most of the organizations engaged in such work to ask and receive the assistance of the American Engineering Standards Association. It provides definite machinery for securing coöperation and preventing duplication of work. It established definite rules securing the absolute autonomy of any group engaged in the development of standards and insures that this group shall receive full credit for its work.

Re-gunning a Battleship's Turrets

(*Continued from page 161*)

ing on shore. The sleeve is removed and placed on the new gun, and the latter is then hoisted on board. A 14-inch gun without accessories of any sort weighs 198,000 pounds—a mass which cannot be toyed with.

After the new guns have been installed in place, the turret top and front armor plates are bolted on. Gunsights, elevating gears and all other mechanisms are assembled, and then a most important operation is commenced. The interior of the turret is thoroughly scrubbed and painted by the turret crew, while the turret captain and gunner's mates clean and polish the guns.

Worn-out guns are by no means consigned to the scrap heap, for they have many years of usefulness before them. The Naval Gun Factory has a large stock of liner forgings always on hand ready to be inserted in guns whose accuracy has been impaired by continuous use. There thousands of the most skilled mechanics in the world work day and night to keep pace with the Navy's requirements. When the worn-out gun arrives it is placed on end in a vertical furnace where it is heated, after which the old liner is knocked out and a new one inserted. For this operation the gun is placed muzzle down in a furnace and heated to a temperature varying from 400 degrees F. to 500 degrees F. A powerful crane lifts the new liner to a position over the furnace and lowers it into place after which it is cooled by sprays of cold water. Hydraulic jacks are used to prevent the liner from crawling out during the cooling process.

When the gun is perfectly cool it is removed from the furnace, and placed in a lathe. It is then chambered, rifled, and fitted with breech mechanism. After being carefully inspected by an officer it is sent to the Naval Proving Ground for test by firing. At the conclusion of this test it is ready for issue to the service, as good as it was when entirely new.

Tobacco Stems

(*Continued from page 162*)

arose as to whether it was paper since for internal revenue purposes there is a difference between paper and tobacco. The process of manufacturing was very similar to that of paper making yet only the tobacco plant was represented in the final product.

As an insecticide, nicotine is valuable because it does not injure the most tender plants; is deadly to a great variety of pests and can be used to advantage with other materials, such as lead arsenate and Bordeaux mixture, without interfering with the effectiveness of either insecticide to any extent. Nicotine enters into our most efficient sheep dips when it accomplishes its purpose without injury to the wool. The Argentine Republic imports more than two million dollars' worth of such sheep dip annually.

Some attention has been given the idea of growing tobacco especially for its nicotine, to be used in insecticides, and data has been published on the following phases of the question: Effect of the soil on nicotine content of the plant, relation of manure to nicotine yield, one combination producting 155 pounds per acre, the best separation of plants, the optimum height of topping, the most favorable time for cutting, the variety producing the most nicotine under the best conditions, drying methods and possible profits, which appear attractive.

Florists and others frequently prepare their own nicotine sprays using waste tobacco purchased locally. Warm water under 60 degrees C. will extract better than 96 per cent of the nicotine and the usual practice is to treat 100 pounds tobacco with three successive 100-gallon portions of warm water allowing each portion to remain in contact with the tobacco for a day. If leaves are used the solution will have a strength proper for spraying (about 0.075 per cent) and the quantity will answer for an acre of plants. To prevent fermentation a small quantity of formalin should be added. If Connecticut stems are used 50 pounds will be required to yield 100 gallons of 0.05 per cent nicotine solution. If dust is used about 35 pounds will answer.

The exhausted waste has some value as a fertilizer owing to the potassium salts, phosphoric acid and nitrogen present as well as the organic matter. Tobacco ashes may contain as much as 43 per cent of potash.

Why experiment? You can be sure

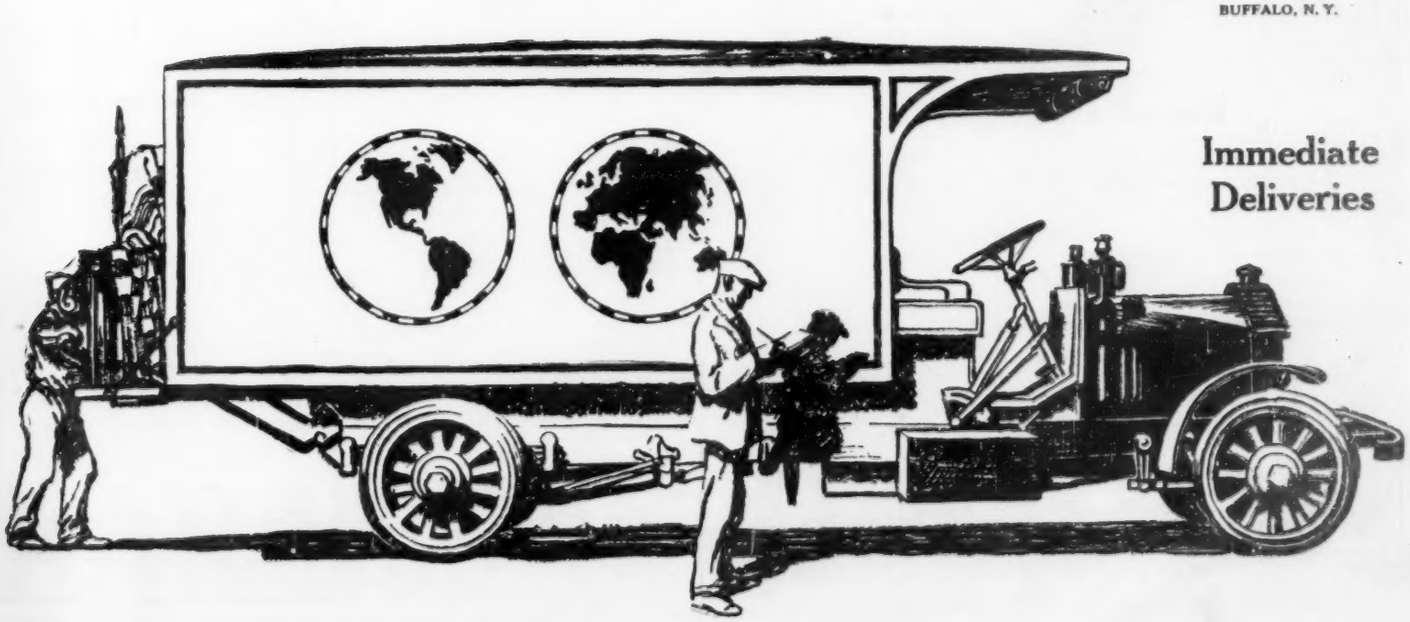
WHEN you can find out what Pierce-Arrow trucks have been doing in businesses like yours, under conditions similar to yours, with like problems to solve, it is foolish to experiment.

We make sure Pierce-Arrows make good by designing them to meet actual conditions, trying them out in every way and following them up day by day in the hands of owners. We know what they have done, and can tell you what they will do for you. Ask us.

Pierce-Arrow

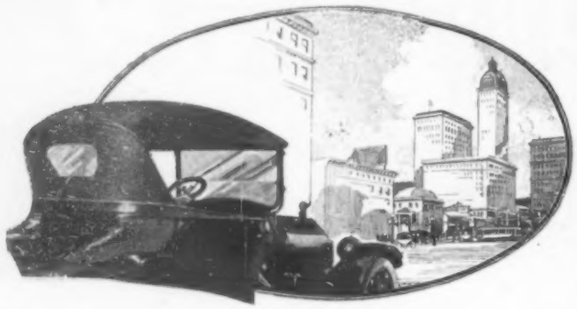
Delivers more work in a given time;
Loses less time on the job and off the job;
Costs less to operate and less to maintain;
Lasts longer, depreciates less and commands a higher resale price at all times.

THE PIERCE-ARROW
MOTOR CAR COMPANY
BUFFALO, N. Y.



Immediate Deliveries

DU PONT AMERICAN INDUSTRIES



Introducing PONTOP

—our newest top material—absolutely the highest quality, rubber-surfaced top material that can be produced.

Pure, live rubber and a super-strong fabric base makes Pontop supreme. Guaranteed one year from date of shipment against leaking, cracking, peeling, blistering and blooming.

On just complaints we will replace the material, its cost of transportation and the labor of replacement.

Write for Samples

Du Pont Fabrikoid Company
Wilmington, Delaware Toronto, Ontario
Visit Du Pont Products Store, Atlantic City

DU PONT

brute strength!

BRUTE strength, scientifically applied, without bulk or clumsiness—that's Williams' "Vulcan" Drop-Forged Clamp.

All Williams' "C" Clamps are built with a purpose for every clamping purpose. Maximum capacity 18".

They are made for Heavy, Medium, Light and Toolmakers' Service by drop-forgers with nearly half a century's experience behind them. They are all guaranteed.

Shall we send you a copy of our booklet describing these Clamps of strength?

J. H. WILLIAMS & CO.
"The Drop-Forging People"

Western Office and Warehouse:
28 S. Clinton Street
Chicago, Illinois

General Offices:
28 Richards Street
Brooklyn, New York

Nitro-Glycerine and the Oil Industry

(*Continued from page 163*)

Colonel Roberts' idea is thus expressed in the words of the original patent grant and he claimed that he secured the idea from the action of a shell which exploded in a mill race at the battle of Fredricksburg. It was not until 1865 that an actual test was made of this new plan and a charge of nitro-glycerine was exploded in the Ladies Well, at Titusville, Pennsylvania. This test was made in the presence of many oil men who were rather skeptical as to the nitro being effective; but the terrible force of the explosion and the fact that the well started flowing oil, at once convinced them. Further tests were made and the "shooting", as it was called, became a common practice. The fluid tamping upon the charge of nitro, which was lowered in the wells in tin tubes, caused the explosion to exert its tremendous force upon the oil-bearing sands, opening great fissures in the sand and tearing a hole which served as a sort of reservoir for the oil. The intensive heat of the explosion melted the accumulations of paraffine and in every degree the process received the stamp of approval from oil-well owners.

The Roberts torpedo was manufactured and sold at a very high price and in many cases, at excessive value. It was for this reason that a series of law suits and injunctions were instigated both by the oil producers and by Colonel Roberts—by the oil men to break the patent and by Colonel Roberts to sustain his patent. These suits and counter suits were for years a scource of tremendous public interest, as no litigations in the United States ever reached such an astounding total in round numbers as that which raged about nitro-glycerine. At the time of his death, Colonel Roberts, alone, had over two thousand suits pending which he had started, and it is claimed the oil men had started as many actions against him.

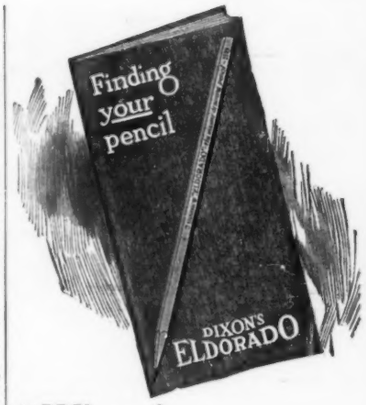
Rather than pay the exorbitant prices charged by the Roberts organization, oil men secured the services of "moon lighters"—intrepid men so designated because they manufactured and shot oil wells at night to escape the attention of the hundreds of spies and agents of the Roberts Company. Constant litigation forced this dangerous work till in the early '80s, when the Roberts patent was revoked.

Today, in every oil field, courageous men—real soldiers of industry—produce nitro-glycerine and other intrepid men take the dangerous fluid to the oil wells in wagons or trucks. These men are very well paid, to be sure; but their work is exceedingly dangerous and each year the explosive exacts a large toll of lives. Sometimes nitro-glycerine explodes by spontaneous combustion, and this is what is always feared by the oil-well "shooter," for when it happens he is dead. This fluid will burn without explosion, but the slightest concussion will set it off. Again a wagon load has been known to upset and be dragged for a half mile by a runaway team and scatter cans among the rocks and not explode. Its freaks are many and would make a large volume of interesting matter if gathered together.

The modern method of "shooting" an oil well still adheres closely to the technique as outlined in the Roberts patent. The nitro-glycerine is carried in gallon cans on a wagon or truck, each can being carried in a cell lined with felt. A screw cap is not used, as the friction might result in an explosion. Corks are used.

A heavy tin tube is lowered in the iron casing at the top of the well and is filled with the nitro-glycerine. When filled, it is lowered to a certain determined depth, opposite and against the oil-bearing sand. Here it is unhooked from the line and the line drawn to the top of the hole, and other similar tubes are lowered until the proper amount is put in the well, This varies in different oil fields on account

(*Continued on page 172*)



"Where's My Pencil?"

HOW many times have you asked that question? Yet have you ever really *found your pencil?* One that feels friendly to your hand—that eases and quickens your work.

You can find this pencil. Our unusual little booklet "Finding Your Pencil" will tell you how. It contains personal information about how to lighten *your* work by using the correct

DIXON'S ELDORADO
"the master drawing pencil"

Write for it today. Booklet No. 121-J

Send 15c for full length samples worth double the money, telling us what work you do and your dealer's name.

Made in 17 LEADS one for every need or preference

Joseph Dixon Crucible Co.
Pencil Dept.121-J, Jersey City, N. J.
Canadian Distributors
A. R. MacDougall & Co., Ltd., Toronto

There is a Dixon-quality Pencil, Crayon and Eraser for every purpose

Knowledge Is Power
—and—
Power Means Money

You can learn more and earn more by reading the Scientific American and getting others to read it.

We want a representative in every community. The prestige and standing of the Scientific American make representing it a dignified occupation.

Liberal commissions and exclusive territory.

Write now for particulars to

Business Manager
SCIENTIFIC AMERICAN
Room 676
Woolworth Bldg. New York City

In cold weather the shutters close automatically, insuring the proper heat for the most efficient operation of the engine.

In warm weather the shutters open wide, insuring the efficient cooling of the engine under the most severe driving conditions

Harrison Shutter-Equipped Radiators Automatically Control Engine Temperature

TO maintain the motor automatically at an unchanging temperature, regardless of changes in climate or season, is the function of Harrison Shutter-Controlled Radiators for automobiles.

Through the use of adjustable shutters, automatically controlled by the Harrison thermostat, the temperature of the motor is kept constantly at the point at which gasoline motors operate with maximum efficiency—approximately 180°.

When the temperature of the motor falls below this efficiency point, the shutters close, conserving the heat. When the temperature exceeds 180°, the shutters open, increasing the cooling power to a maximum. Because of this shutter-control, a radiator can now be built large enough for the unusual cooling demands of summer and yet be regulated to operate at diminished capacity in winter.

This Harrison achievement in automobile cooling systems means much to the motorist—in ease and convenience of driving as well as in substantial economies. The motor warms quickly, facilitating starting.

The driving temperature is kept uniform, improving carburetion and ignition. And operation under correct temperature conditions makes for the economy of gasoline and oil. When buying your next motor car, you will assure yourself of a new satisfaction in motoring if you choose a car equipped with the Harrison Shutter-Controlled Hexagon Radiator.

Harrison Radiator Corporation

General Sales Offices: Detroit, Mich.

General Offices and Factory: Lockport, New York

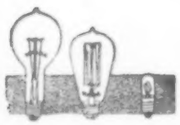
HARRISON *Shutter-Controlled Hexagon* **Radiators**

MAZDA

"Not the name of a thing, but the mark of a service"

MAZDA is the trademark of a world-wide service to certain lamp manufacturers. Its purpose is to collect and select scientific and practical information concerning progress and developments in the art of incandescent lamp manufacturing and to distribute this information to the companies entitled to receive this service.

MAZDA Service is centered in the Research Laboratories of the General Electric Company at Schenectady, N.Y. The mark MAZDA can appear only on lamps which meet the standards of MAZDA service. It is thus an assurance of quality. This trademark is the property of the General Electric Company.



A MAZDA Lamp for every purpose

4547

RESEARCH LABORATORIES OF GENERAL ELECTRIC COMPANY

THE BRIDGEPORT CHAIN CO.
Specialists in Small Wire Shapes & Flat Stampings
Bridgeport, Conn.

INSYDE TYRES Inner Armor for Auto Tires. Double mileage, prevent blowouts and punctures. Easily applied in any tire. Thousands sold. Details free. Agents wanted. Amer. Accessories Co., Dept. 5 Cincinnati

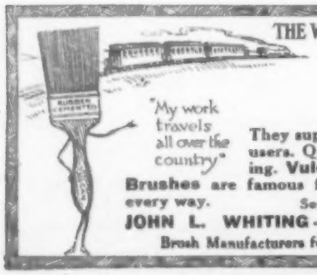
EXPRESS SERVICE
MASON'S NEW PAT. WHIP HOIST
Comparative cost 40 foot lift:
By elevator—5 men, 50 bales of wool per hour
By Mason's Whip—3 men, 90 bales of wool per hour
One rope hoists, lowers and holds the load
Manufactured by VOLNEY W. MASON & CO., Inc.
Providence, R. I., U. S. A.

PLATINUM

If you have platinum ores or sands which appear low in metal and hard to work, consult us immediately. Our processes bring big returns from low yielding ores at low costs.
Twenty-two years' experience in testing and extracting platinum, and other precious metals from all kinds of ores and sands.
We invite consultation and will suggest and install correct processes for profitably working your ores.
Fullest investigation by capitalists and mine owners solicited.
OGDEN LABORATORIES, Metallurgical Experts
230 Chancellor St., PHILADELPHIA

A New Invention
THE EAGLE AUTOMATIC VALVE GRINDER

Greatest Labor and Money saver ever brought out to enhance Automobile Efficiency guaranteeing more mileage, a saving of gas and the elimination of ninety per cent motor trouble—Lasts a life time—Easy to use—Saves its cost every-time you grind your valves.
Agents Wanted
$25 to $50 a day, easily made—Dont miss this—Greatest Seller on Record. Write for Free Descriptive Circulars. Address
THE EAGLE MFG. CO. 203 CINCINNATI, O.



THE WELFARE AGENTS OF THE RAILROADS ARE
WHITING-ADAMS
BRUSHES
"My work travels all over the country"
They supply all Brush needs of Railroads and similar users. Quality highest. Long wearing, perfect working. Vulcan Rubber Cemented Wall and Stucco Brushes are famous for strength and lightness. Guaranteed in every way.
Send for Illustrated Literature
JOHN L. WHITING-J. J. ADAMS CO., Boston, U. S. A.
Brush Manufacturers for Over 109 Years and the Largest in the World

Nitro-Glycerine and the Oil Industry

(Continued from page 170)

of the thickness and porousness of the oil sands, but the average amount will usually run about 100 quarts at a depth of about a thousand feet.

Once the tubes, called shells, are all in place, the tamping is placed. This is usually water or oil, as both are very good. This is often poured in until the depth above the nitro is several hundred feet. The nitro-glycerine is a very heavy fluid and will not rise to the top of the tamping.

To complete the matter, a stick of dynamite is placed in a small tin tube and a short water-proof fuse lighted. The "shooter" then drops this in the hole and the spectators and workers run to a point of safety, which is usually about 300 yards. All is silent. Suddenly the ground is shaken and a sharp report is heard no louder than a pistol shot. A dull roar comes from the direction of the oil well, and a short spray of oil and water rises above the hole. The roar increases and a great volume of oil, water and sand mounts to a height of several hundred feet above the hole. This mounts to the zenith and diminishes to a flow of oil that will be diverted into tanks and out to an oil refinery where it takes its place in the lubrication, lighting and heating of the world.

As an industrial agent nitro-glycerine has added millions of dollars to our national wealth, by increasing and sustaining the production of petroleum upon which we lean so heavily to keep the wheels of industry turning.

Trucking Freight Over Gobi Desert

(Continued from page 164)

anything in the nature of such service in this country seems to be relatively easy. These trucks are to make the trip from the port to colonies in the vicinity of Kulja, China, approximately 2000 miles in the interior and which are without any means of communication save by roads and caravan routes across the Gobi desert. It has been the custom to send a caravan consisting of camels carrying packs from Tientsin, the well-known port, several times a year.

The average camel load is about 200 pounds and the daily mileage is about 20 so that about six months is required for the round journey of 4000 miles. On the march from Tientsin to Kulja food, seed, supplies, etc., are carried and returning various agricultural products are packed. As might be assumed the cost of transportation is very great, despite the cheapness of labor and camels, and the value of anything carried by caravan is much increased when delivered at its destination. This large cost impelled the Eastern Turkestan Agricultural Colonization Company to purchase trucks which will replace the camels, and these will be used with trailers so that the load capacity of each haulage unit will be six tons. The expectation is to make the round trip in about 30 days, carrying a total of 180 tons. The 30 trucks are intended to equal in freightage, a caravan of 4,000 camels and 1,000 men, which would have a total freight tonnage not exceeding 400 tons. The caravan could possibly make two yearly trips, carrying 800 tons, and the trucks will carry 2000 to 2200 tons in the 12 monthly trips. The operating plan is to establish stations at intervals of about 200 miles, where water, fuel, lubricant and facilities for making ordinary repairs will be maintained. The trucks will be driven by Chinese drivers, who will be instructed by an American expert, who was employed at the truck factory and who is accompanying the machines to China to become superintendent of operations.

Besides the 30 trucks, equipment for two complete machine shops, including lathes, drill presses, grinders, shapers, forges and all the machine and hand tools required for such service stations as are the vogue in America was shipped. One shop will be at Tientsin, and the other at Kulja, and between these there will be nine other shops, where whatever attention is necessary may be given. Besides the equipment stated three extra sets of tires, or 360 in all were sent with the trucks which will be used as wanted and replenished as necessary, also a very complete outfit of spare parts. The progress of the experiment will be watched with interest as this will be service that will try the trucks to the utmost.

Medium Capacity Trucks Popular

IT is stated that statistics compiled of the 1919 truck production in the United States, show a total contemplated product of 350,000 motor trucks and that a large proportion of these will be trucks of about one ton capacity; in fact, it is estimated that 55 per cent. of the total production will be one- and two-ton trucks. The figures given below are interesting as they represent the researches of a prominent truck maker who says:

"The country will absorb over 138,700 one-ton trucks in 1919, or 40 per cent of the estimated production. The next largest number to be produced will be of the two-ton capacity of which close to 50,000 will be manufactured, or 15 per cent. of the estimated total. Taking the various capacity ranges we find that 9,300 trucks of one-half ton capacity are to be built: 30,040 of three-quarter ton: 43,400 of 1½-ton: 10,060 of 2½-ton: 6,155 of three-ton: 19,210 of 3½-ton: 1,150 of four-ton; 16,992 of five-ton; 1,000 of 5½-ton; 1,070 of six-ton and 950 of seven-ton.

In 1912 the truck production was estimated at 50,000 commercial vehicles and 34,701 were manufactured; in 1913 there were manufactured 59,672; in 1914 there were manufactured 44,043; in 1915 manufactured 65,288; in 1916 manufactured 101,061; in 1917 manufactured 128,157; in 1918 manufactured 227,250, and in 1919 the peak will touch 350,000.

In 1918 of the trucks manufactured 47.9 per cent. were of one ton or less capacity; 37.6 per cent. 1½- to 2½-ton capacity; 11.9 per cent. three- to four-ton capacity; 2.4 per cent of five ton and 0.2 per cent of more than five-ton capacity. And the good roads program which will be under way in the near future will greatly increase production of one- and two-ton truck models."

Rubber Mat for Baggage Transfer Trucks

WHAT is probably one of most surprising accessories for trucks used for transporting trunks and baggage is used by a haulage concern in Los Angeles. This company carries thousands of trunks annually. The weights of these vary greatly. Two men is a rather expensive crew for a light baggage truck and while one man can perhaps handle average weight pieces with reasonable rapidity when accustomed to the work, the trunks will generally suffer because they are often dropped from the truck to a hard sidewalk or roadway.

This company has provided a large mat for each of its trucks made of fifteen to twenty sections of heavy air hose from 1½ to 2½ inches diameter. Through the hose sections, about 2½ inches from the ends, quarter-inch holes are bored, and steel rods are passed through the holes and secured at the ends by locked nuts, these serving to tie the hose sections together to form a resilient mat. These are carried on the truck and before unloading one or more trunks the mat is thrown under the tailboard. The trunks may be dropped on these without danger of damage, no matter how rapidly they are handled. The time of the drivers and the trucks are economized and the customers are better satisfied because their baggage is handled without damage. The cost of the equipment is exceedingly small. So far as known this concern is

(Continued on page 174)

Are you playing nurse to makeshift ignition?

Is it one of those ignition systems whose *last* consideration is ignition—

That first must start your engine, then light a half dozen lights and operate your horn?

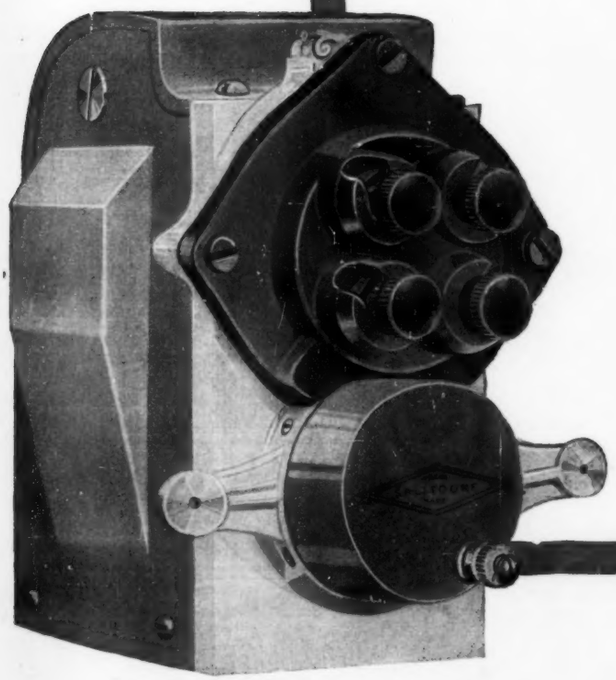
Is it one of those ignition systems that must be nursed and watched and worried over—that may become short-circuited through an accident to the complicated wiring and leave you stalled?

This is not an indictment against the battery, for the battery is essential to the starting and lighting of the modern car—

It is just an argument against the foolishness of depending upon such a complex system to fire your engine—to supply the vital spark without which the whole car is useless.

The Splitdorf Magneto generates the spark as it is needed—and just for what it is needed—ignition.

It is entirely self-sufficient, self-contained ignition that generates a hotter, stronger spark, even for starting, than any other ignition system—and its strength increases with the speed of the engine.



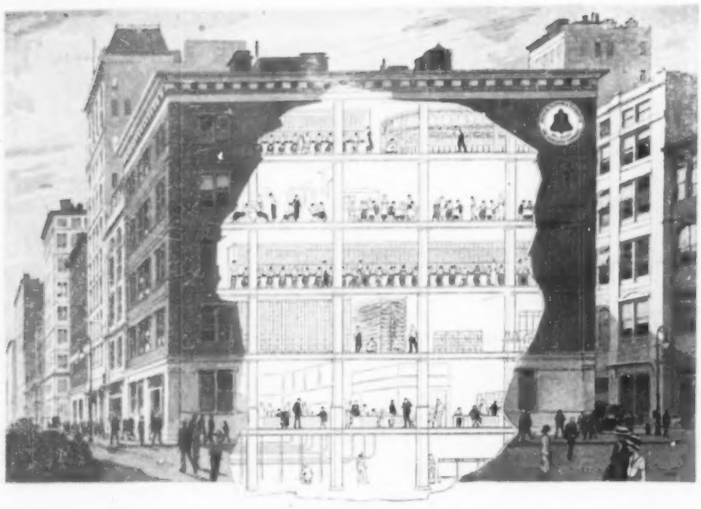
SPLITDORF

Electrical Co., Newark, N.J.

Sumter Division, 1466 Michigan Ave. Chicago

TRADE SPLITDORF MARK

Manufacturers of AERO, DIXIE and SUMTER Magnetos, Oscillating Magnetos and Impulse Starters



The Great Task of Construction

With the coming of peace the Bell System faced an enormous construction program. Conditions arising from war resulted in the wiping out of the reserve equipment normally maintained, and necessary to give prompt connection to new subscribers. The release of industry and accumulated growth of population now makes telephone demands almost overwhelming.

Telephone construction, including buildings, switchboards, conduits, cables and toll lines, must, from its inherent nature, be undertaken in large units. A metropolitan switchboard, with its tens of thousands of parts, may require from two to three years to construct and install.

Only great extension can meet the present excess burden of traffic and provide for future requirements. Extension which cares for immediate demand, only, is uneconomical and calls for continuous work of such a character as to be frequently detrimental to the service.

During the war the Bell System devoted all its margin to the needs of the Government. The great task of getting back to normal pre-war excellence of operation requires the reestablishment of an economic operating margin capable of taking care of a larger growth than has ever before confronted the Bell System.

Construction is being pushed to the limit of men and materials; while every effort is being made to provide the best, present service.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

GASOLINE AND KEROSENE CARBURETORS

By Major Victor W. Pagé, U. S. A.

THE carburetor is that magical little device that turns a fluid into a gas that turns the wheels that devour the distance. To the reader of Major Page's new handbook, the carburetion chamber ceases to be a chamber of mystery; in seven chapters the whole construction, principle and practice of the device are revealed for the benefit of operators and repairmen.

All suitable liquid fuels and the various methods of feeding them are critically discussed; all the most recent types of carburetors are minutely described as to form and functioning, with especial consideration given to those designed to use the cheaper fuels; indeed, it will be hard to find elsewhere such a complete exposition of the kerosene carburetor as the author has given us here. There is a chapter on installation on manifolds, and another on faults, their location, and the remedies; repair work is made a feature of the treatise. In short, the whole field of modern practice is illuminated. Numerous accurate drawings show all parts in their working relationships, and put before the student the mechanism of the leading types.

5x8. 320 pp. 89 ill. $1.50, by mail $1.65

SCIENTIFIC AMERICAN PUBLISHING COMPANY
233 Broadway, New York

Rubber Mat for Baggage Transfer Trucks

(Continued from page 172)

the only one that has used unloading mats, but there appears to be no reason why such mats could not be very widely utilized, at least by concerns that have to handle fragile cases and bulky but light packages of different kinds, and want to do their work with the smallest number of men.

New Army Searchlights Built as Truck Trailers

A NEW searchlight which will be exceedingly useful in connection with anti-aircraft operations, has been developed by army engineers. The searchlights have been mounted on a trailer which runs on rubber tired wheels and by means of a motor truck are conveyed great distances with the least possible loss of time.

The first light developed was 24 inches in diameter, then came a 36-inch light and finally a 60-inch light of the "dishpan type" which as its name implies, is shaped like a dishpan and consists of a mirror and its support. A 60-inch light formerly weighed 6,000 pounds, but the experts have succeeded in reducing the weight to less than 700 pounds, thus making the light much more portable and requiring less draft to move.

The cost of the new light has been reduced to about one-fourth of the cost of the first product and the facilities for manufacturing it have been greatly increased. Many interesting experiments are now in progress. The old searchlight had a glass mirror which was very heavy and could be produced by only a few firms. One part of the development has been to perfect a mirror of a thin metal backed with reenforced concrete which promises excellent results.

Recent Patent Decisions

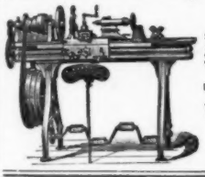
The Prosser letters patent, declared to have been by defendant infringed upon, covered what is commonly called in oil-drilling operations a swivel jar socket, as fully described in a copy of said letters patent filed. The two distinctive features of this socket were the jar allowed in drilling operations, and the swivel to which the wire rope was attached turning in the socket head. After the entry of decree herein defendant company, through its president, Charles A. Towne, conceived the idea, if the swivel head turning within the socket should be flattened on one of its sides by a groove cut therein, and a hole bored through the socket, and a pin inserted therein, thus making the socket a stiff wire rope socket in operation, instead of a swivel jar socket, infringement of plaintiff's rights would be avoided, and the injunctive order in this case not violated. This was done, and defendant pursued the business of manufacturing its drilling sockets in substantial conformity with the Prosser patent save and except with the added slot cut in the swivel and pin passing through the socket. This addition in fact did, as long as the pin remained inserted through the socket, convert the former Prosser swivel or turning jar socket into one that did not act as a swivel in its operation. However, the proofs disclose, that which is on its face self-evident, if the inserted pin be by the workman using the tool withdrawn from its place, or in operation should become worn out or broken at times, the socket became in its operation a Prosser swivel jar socket.

Held, that where a defendant was adjudged to have infringed a patent, and an injunction was issued, he was guilty of contempt in continuing to make similar articles, although there was a change, where the change made from the original infringing device was merely colorable, and not substantial, and the court could clearly see the obvious intent to further infringe upon the rights protected by the decree.—*Wire Rope Appliance Co. v. Eureka Tool Co. District Court of Kan.*

Monarch Lathes
Quantity production of a high class machine tool has made possible the low price of MONARCH Lathes.
Made up to 30 in. swing. Every one guaranteed to give satisfaction to the purchaser. There is a Monarch lathe to meet your needs. Write for a catalog.

The Monarch Machine Tool Co.
America's Largest Lathe Builders
103 Oak Street Sidney, Ohio

For Gunsmiths, Tool Makers, Experimental & Repair Work, etc.



From 9-in. to 18-in. swing. Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle.
W. F. & J. Barnes Co.
Established 1872.
1999 Ruby Street
Rockford, Ill.

SOUTH BEND LATHES
Established in 1906 Over 20,000 South Bend Lathes in use

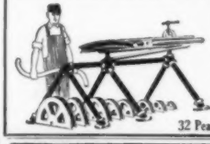
For the Machine and Repair Shop
LOW IN PRICE
13 in. to 24 in. swing
Straight or Gap Beds
Send for free catalog giving prices on entire line
South Bend Lathe Works
421 Madison St.,
South Bend, Ind.

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous BELL ASBESTOS MINES in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.
For anything you want in Asbestos, turn to
KEASBEY & MATTISON COMPANY
DEPT. S-1
AMBLER, PENNA, U. S. A.
Owners of the world's largest Asbestos Mines

NOVELTIES & PATENTED ARTICLES
MANUFACTURED BY CONTRACT. PUNCHING DIES.
LIGHT AUTOMOBILE STAMPINGS
E. KONIOSLOW STAMPING & TOOL WORKS, CLEVELAND, O.

POWER BENDERS THREE NEW MODELS



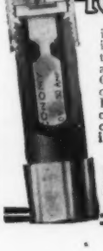
"Wonder" Pipe Bending Machines (pat.) electrically operated to bend from 1 inch to 18 inches. Send for printed matter. We also manufacture TEN other sizes, hand operated to bend from 1-8 inch to 8 inches.
American Pipe Bending Machine Co.
Manufacturers
32 Pearl St., Boston, Mass. U. S. A.

THE SCHWERDTLE STAMP CO.
STEEL STAMPS LETTERS & FIGURES.
BRIDGEPORT CONN.

WELL DRILLING PAYS WELL
Own a machine of your own. Cash or easy terms. Many styles and sizes for all purposes
Write for Circular.
WILLIAMS BROS., 434 W. State St., Ithaca, N.Y.

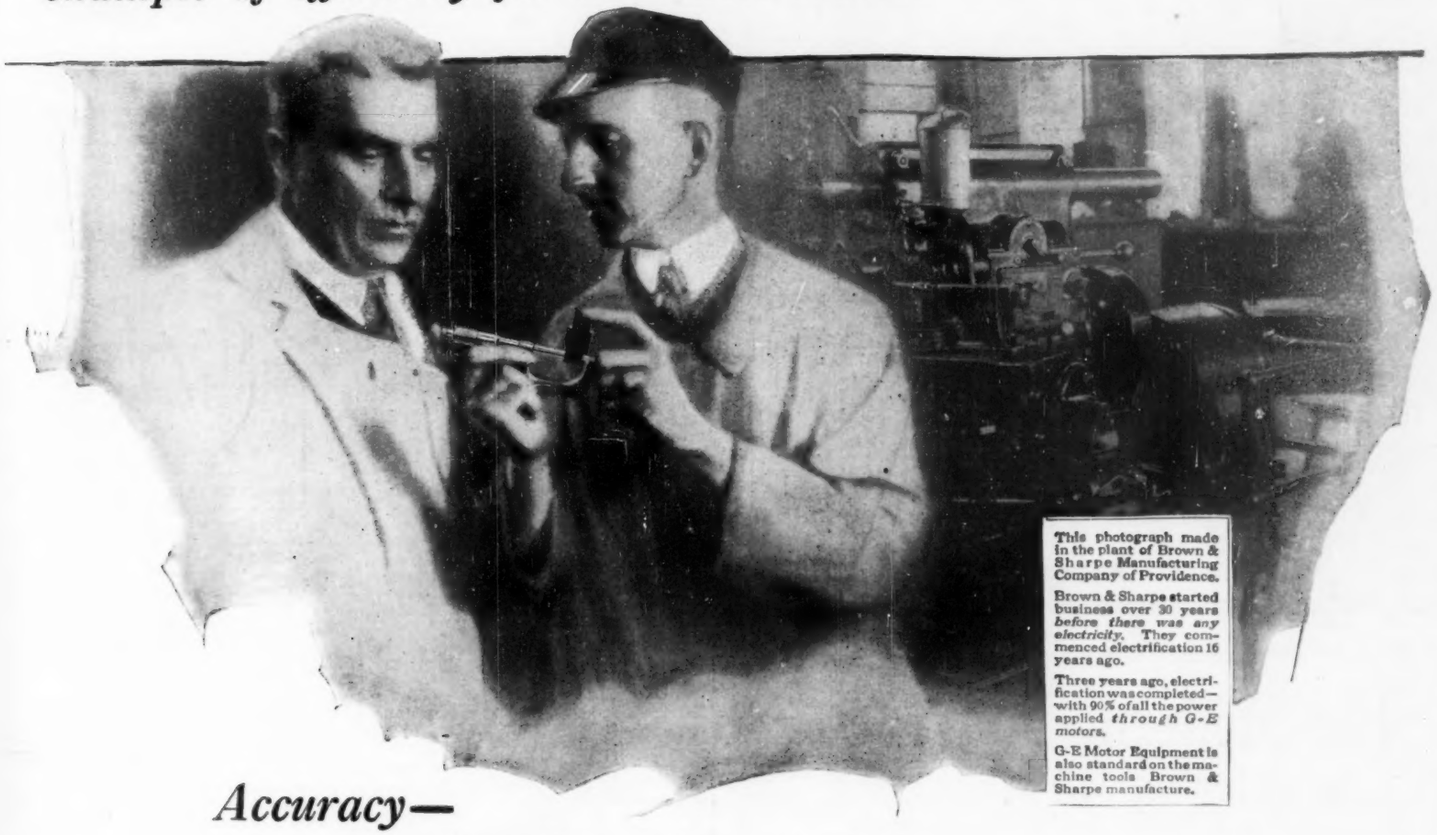
SOLVINE BOILER PRESERVER
Warranted, without reserve, to remove boiler scale prevent pitting and scale formation.
Pamphlet on request. Money back guarantee.
SOLVINE MFG. CO. Jersey City, N. J.

ECONOMY renewable FUSES



insure maximum safety and minimum cost in safeguarding electrical circuits against the fire and accident hazards of overloads and short circuits. An inexpensive "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency. The Economy is a pioneer renewable fuse. As compared with the use of one-time fuses, it cuts annual fuse maintenance costs approximately 80 per cent.
ECONOMY FUSE & MFG. CO.
Kinzie and Orleans Sts. CHICAGO, U. S. A.
Sole manufacturers of "ARTLESS"—the Non-Renewable Fuse with the 100% Guaranteed Indicator.
Economy Fuses are also made in Canada at Montreal

The wide use of General Electric Motors—precision instruments themselves—has helped make "American standardization" an example of efficiency for the whole world.



This photograph made in the plant of Brown & Sharpe Manufacturing Company of Providence.

Brown & Sharpe started business over 30 years *before there was any electricity.* They commenced electrification 16 years ago.

Three years ago, electrification was completed—with 90% of all the power applied *through G-E motors.*

G-E Motor Equipment is also standard on the machine tools Brown & Sharpe manufacture.

Accuracy—an American characteristic

ACCURACY finds its highest expression in what the world calls *American standardization.*

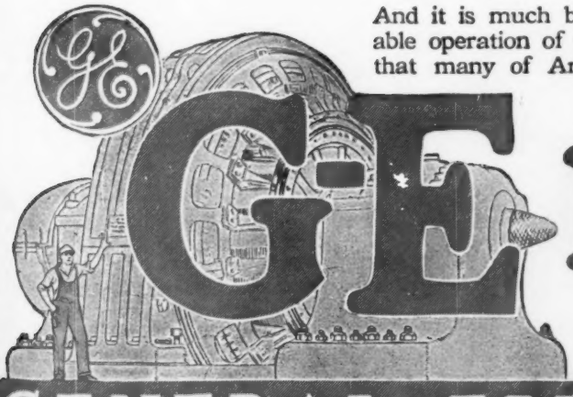
It is attained by the accuracy of the men and tools which produce it.

The highest accuracy in men and tools depends a good deal on the way power is applied *and controlled.*

And it is much because of the dependable operation of G-E motor equipment that many of America's industries are achieving fame for accuracy, efficiency and quality. Accuracy is the element that makes watches "keep time"; makes automobiles save "gas"; makes cooking a science. Accuracy determines efficiency. Accuracy, plus speed, does America's work in the eight-hour day.

To get accuracy and its by-products—dependability and efficiency—call in a G-E Power Specialist. General Electric Company, Schenectady, New York.

Look for it—the mark of leadership in electrical development and manufacture



G-E motors

—from the Mightiest to the Tiniest

43-334

GENERAL ELECTRIC COMPANY

The Yale Spur-Geared
Chain Block takes the place of them all.
WITH the Yale Spur-Geared Chain Block and the Brownhoist trolley, the handling of loads is made safe, speedy and efficient.
It takes the place of the old-fashioned rope-and-pulley, the cumbersome floor truck and the make-shift-crowbar-and-rollers. It multiplies the power of one man so that he can easily handle loads that would require the efforts of many men. And he can handle them with entire safety to himself and to the loads.
Wherever there are loads to be handled—there is need for the Yale Spur-Geared Chain Block.
'From-Hook-to-Hook-a-Line-of-Steel'
Catalog 18D tells all—or ask your Machinery Supply House.
For a Factory Locking Equipment use a Yale Master Key System.
Write for Particulars
The Yale & Towne Mfg. Co.
9 East 40th Street New York City
FROM HOOK TO HOOK A LINE OF STEEL
TRADE YALE MARK
The YALE SPUR-GEARED BLOCK takes the place of them ALL!
The ROPE and PULLEY
The FLOOR TRUCK
The CROWBAR and ROLLERS
The YALE SPUR-GEARED BLOCK takes the place of them all -and more!

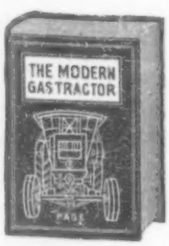
The Modern Gas Tractor

By MAJOR VICTOR W. PAGÉ, M.E.

Author of "The Modern Gasoline Automobile," Etc.

504 Pages (5x7½) Handsome Cloth Binding 228 Illustrations
Three Folding Plates

Price $2.50 By Mail $2.65



A complete treatise describing all types and sizes of gasoline, kerosene, and oil tractors. Considers design and construction exhaustively, gives complete instructions for care, operation and repair, outlines all practical applications on the road and in the field. The best and latest work on farm tractors and tractor power plants.

THIS work is written by a recognized authority on self-propelled vehicles and internal combustion motors. Everything is explained so simply that anyone of average intelligence may obtain a comprehensive knowledge of gas tractor operation, maintenance and repair. Tells how they are constructed and explains fully the reasons for varying designs. Contains special chapters on driving the tractor on field and road, what to expect from tractors in various kinds of work, cost of operation and money-making hints on repairs. It describes all ignition systems, all kinds of gasoline and kerosene vaporizers and carburetors, latest forms of power plants and installation, clutches, speed changing and reversing gears and all frame parts and their functions. Tells how to tell brake horse power from drawbar or horse equivalent power, how to make adjustments to power plants, change speed gearing and other parts. Describes tools for tractor repair and gives plans for tractor sheds so they can be used in winter for stationary power or workshops where all repairs may be made. Outlines control systems of leading types and shows simple hitches for working various implements in combination. Describes fully tractors for small farms and orchards as well as types of the largest capacity. All illustrations are plainly marked with all important parts indicated so they may be easily identified. Drawings are simple but in correct proportion. Every illustration has been specially made for this book.

SCIENTIFIC AMERICAN PUBLISHING COMPANY
233 Broadway, New York

NEW BOOKS, ETC.

EFFICIENT RAILWAY OPERATION. By Henry S. Haines. New York: The Macmillan Company, 1919. 8vo.; 709 pp.

It is but 90 years since Stephenson's "Rocket" burst upon a skeptical world; now there are 350,000 miles of railroad in this country alone. Mr. Haines, in an authoritative work, brings together the most interesting and vital facts concerning railways, their evolution, efficient management, motive power, rolling stock, roadway, traffic, transportation, and operation in peace and war. Most useful statistics and data are given in appendixes, and there is a well-chosen bibliography. Comparative descriptions of home and foreign railways are sharply drawn, and the exposition will be of great value to students in technical schools and to junior railroad employees; it is at the same time so readable as to be understood and enjoyed by the general public.

INDUCTION COILS IN THEORY AND PRACTICE. By Prof. F. E. Austin, E.E. Box 441, Hanover, N. H.: F. E. Austin, 1919. 8vo.; 64 pp.; illustrated.

Professor Austin has written numerous handy little books on electrical devices and practice; he deals here with one of the most important contrivances, the induction coil, to which we owe the efficient operation of automobiles, telephones, wireless, and X-ray diagnosis. He states the fundamentals so that the student may construct coils for various purposes, and will lay down the book with his knowledge clarified and augmented.

THE BOOK OF THE HOME GARDEN. By Edith Loring Fullerton. New York and London: D. Appleton and Company, 1919. 8vo.; 260 pp.; illustrated.

Many amateurs plant and cultivate conscientiously, but overlook the importance of proper picking. All the letters which spell success in gardening will be found in this alphabet of the art by one of the foremost woman experts. The fact that her material was originally worded for children guarantees the simplicity of the directions given; and while vegetables occupy most space several chapters are devoted to flowers. The secrets of the friendly soil are revealed, and Mr. Fullerton, chief grub scout of the Boy Scouts of America, has supplied the attractive illustrations.

OUTLINES OF ECONOMIC ZOOLOGY. By Albert M. Reese, Ph.D. Philadelphia: P. Blakiston's Son and Company, 1919. 8vo.; 316 pp.; 194 illustrations.

Dr. William T. Hornaday regards economic zoology as the most important branch of this science, and declares that our institutions of learning are, in the teaching of it, a quarter of a century behind the times. Zoology, in its relation to public welfare, shows us our friends and our foes, and is of vital importance to our well-being. Prof. Reese's text takes the economic aspect as the main point of attack; it may be used as a separate course for students already grounded in general zoology; may be utilized as supplementary reading; or should be especially valuable to agricultural students.

EXAMPLES IN ALTERNATING CURRENTS. Vol. I. By F. E. Austin, B.S., E. E. Hanover, N.H.: F. E. Austin. 12mo.; 223 pp.; illustrated.

This text comes to the assistance of the college student and also furnishes expert guidance to those attempting this subject by themselves, enabling them to apply fundamental principles in engineering practice. The results of the problems offered, and the selected tables, are also of value to the practicing engineer. The work is meant, not as a text book, but as an auxiliary to any text that may be used.

LABORATORY EXPERIMENTS WITH DIRECT-CURRENTS. By Prof. F. E. Austin, E.E. Hanover, N. H.; F. E. Austin. 8vo.; 155 pp.; illustrated.

A well-known educator, a specialist in industrial and technical school texts, here develops the engineering applications of direct-current theory in their relations to everyday life, and seeks to inculcate initiative and executive ability. The experiments may be covered in 40 laboratory hours, with an additional allowance of 20 hours for computations and drawing.

THE SUMNER LINE. Or Line of Position as an Aid to Navigation. By George C. Comstock. New York: John Wiley and Sons, Inc., 1919. 16mo.; 70 pp.; diagrams and folding inserts.

Those possessing an elementary knowledge of navigation and desirous of a working acquaintance with the Sumner method of determining position at sea will find a concise guide in this small handbook. Using the tables issued by the Navy Department, this method resolves itself into comparatively simple operations, notwithstanding a prevalent idea to the contrary.

THE ELEMENTS OF ASTRONOMY FOR SURVEYORS. By R. W. Chapman, M.A. Philadelphia: J. B. Lippincott Company, 1919. 8vo.; 247 pp.; 56 diagrams.

Textbooks on surveying usually give formulas for the reduction of the observations without delving very deeply into the principles from which the formulas are derived; if a student has a healthy curiosity that induces him to peep behind the formula, he must resort to an astronomical work in which the mathematical theory is developed with little heed to his special interests and may easily find himself beyond his depth. Professor Chapman has met the difficulty with this elementary exposition of the practical methods of observation and computation and of the chief principles the surveyor should hold in his mental grasp.

OFFICIAL AMERICAN TEXTILE DIRECTORY. 1919. New York: Bragdon, Lord and Nagle Co. 8vo.; 828 pp.

Each year, the *Textile World Journal* compiles this most complete and accurate directory, with reports of practically all the textile manufacturing establishments in the United States and Canada; it includes also a yarn trade index, and lists of firms in lines of business selling to or buying from textile mills. Accuracy is assured by a system of personal canvass and by official reports from the trade. The various alphabetical indexes, and the scheme of alphabetical and geographical arrangement, make any item of desired information instantly available to the hand and the eye. Buyers and sellers generally are well acquainted with the merits of the work; it is an indispensable desk book for the textile and allied industries.

THE REALITIES OF MODERN SCIENCE. An Introduction for the General Reader. By John Mills. New York: The Macmillan Company, 1919. 8vo.; 327 pp.; illustrated.

The author has an almost uncanny recognition of what the layman particularly wishes to know. It is amazing how few persons have orderly ideas as to the nature of molecules, atoms, and electrons, to say nothing of their behavior under varying influences. This exposition of the constitution of matter, prefaced by sketches of the beginnings of knowledge and science, is one of the most lucid we have seen, and the writer's ability to simplify involved subjects is strikingly apparent in the pages dealing with the Brownian movement. To the questing type of mind, his volume will prove as absorbing as a great novel.

HOW TO UNDERSTAND THE READING OF BLUE PRINT DRAWINGS. By Edward R. Vigneau, I.E. 100 Rowland Building, Detroit: Educational Institute. 12mo.; 169 pp.; 228 illustrations.

Using simple objects upon which to base instruction, the author has placed before mechanics a clear explanation of the elements of blue print drawings. He discusses elevation, different number of details, angle projections, cross sections, and assemblies, together with much miscellaneous information that will enable the student to ground himself in the fundamentals and thus prepare for reading the more complicated drawings.

OUR FIRST AIRWAYS. Their Organization, Equipment, and Finance. By Claude Grahame-White and Harry Harper. New York: John Lane Company. 12mo.; 185 pp.; 11 plates.

The writers have been actively interested in aviation from its early days; recently they have lived in the midst of the phenomenal progress made by Britain under the urgency of war. In their latest book they consider at length three vital questions, the answers to which will determine the status of commercial flying: Can it be made safe? Can it be made reliable? Can it be made to pay? They answer these queries in the affirmative, and the evidence on which their conclusions are based, and through which they look forward to a world covered with a network of aerial ways, makes encouraging and informative reading.

OPPORTUNITIES IN CHEMISTRY. By Ellwood Hendrick. New York: Harper and Brothers, 1919. 12mo.; 102 pp.

To the thoughtful man who wants to know all there is to know about his own particular work, questions that can only be answered by the science of chemistry are very apt to present themselves, no matter what his field may be. Such opposite occupations as fire insurance and agriculture are instances. Mr. Hendrick, in these friendly talks, shows how a working knowledge of chemistry may be acquired and turned to good use; he rough-sketches the wide and ever widening scope of that science in its application to industry, and his little book will endow many with a broader view that may lead to greater success.

SAY, what a trick you'll turn for your tongue and taste and temper when you finally get down to bed-rock-smokes and let some of that topjoy Prince Albert float into your system! Just will put the quiz into your thinktank as to how much pipe or cigarette-rolling fun you've gone shy on—and, you'll work in a lot of double headers for quite a spell to get all-square!

What's the idea kidding yourself when you know what P. A. will do for your smokespot; when you know what it is doing for men all over the civilized world! You can't hit a happier job than to stock a supply of Prince Albert, jam that joy'us jimmy-pipe chuck-full and blaze away! Why, it's like falling into feathers when you've been batting-it-out-on-a-board!

Prince Albert just can't help doing you a clever turn because it won't bite your tongue at any stage! Bite and parch are cut out by our patented process. Want you to know right here, and now, that Prince Albert will be as gentle with your tongue as a toy purr-kitty is with a stuffed mouse! You can rip champeen-smokespeed-records right up the back with P. A. for packing!

You don't need a percentage table to figure out what Prince Albert's quality and flavor and fragrance will do for your happiness every time the clock ticks! You'll get the answer quick! And, now it's your draw! Prince Albert is sold in toppy red bags, tidy red tins, handsome pound and half pound tin humidors, and, in that classy, practical pound crystal glass humidor with sponge-moistener top that keeps the tobacco in such perfect condition!

R. J. REYNOLDS TOBACCO COMPANY
Winston-Salem, N. C.

PRINCE ALBERT

the national joy smoke

General Motors Trucks

—and Business Prestige

IT would be hard indeed to find a better example of the sort of prestige coveted by all high class retail business than that of The Bailey, Banks & Biddle Company, the famous jewelers of Philadelphia.

Founded in 1832, this house is a Philadelphia institution Through more than four score years it has been accorded the patronage of the fine old aristocratic families of America's first capital.

Nearly 100 years ago The Bailey, Banks & Biddle Company sold its precious wares of jewels and plate in a quaint colonial shop and delivered them in a horse-drawn coach.

Today the company occupies a magnificent modern store, containing so extensive a collection of precious stones, jewelry, and objets d' art that it is one of the showplaces of Philadelphia.

And today The Bailey, Banks & Biddle Company is using for its delivery service five GMC Trucks finished and appointed in a style appropriate to their occupation.

The Bailey, Banks & Biddle Company bought the first three in 1915, and in the following year purchased two more, making a fleet of five which has now been in service from three to four years.

GMC Trucks are for high class concerns that want their delivery equipment properly to represent them in appearance and performance. GMC reliability has become proverbial—GMC construction is the reason.

The General Motors Corporation gives to GMC Trucks a financial backing that assures permanent availability of service and parts.

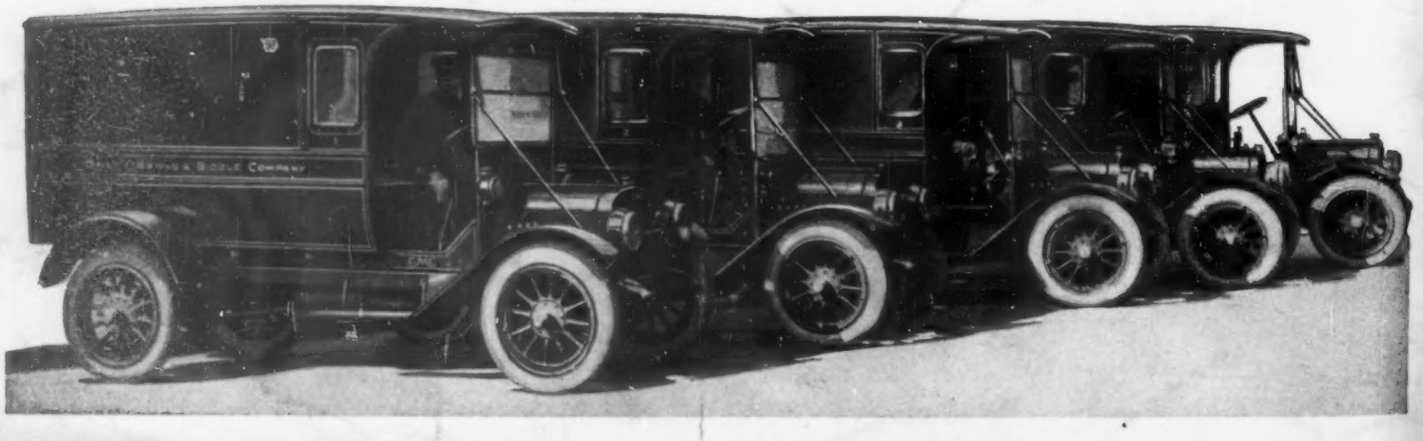
THE GMC FRONT AXLE

Great tensile strength with light weight are combined in GMC Front Axles. Special analysis steel, heat-treated, is employed, with steering knuckles and knuckle arms drop-forged and heat-treated.

GENERAL MOTORS TRUCK COMPANY

One of the Units of the General Motors Corporation

PONTIAC, MICHIGAN, U. S. A.

Branches and Distributors in Principal Cities

(530)